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PLASTIC RECONSTRUCTION OF THE BLADDER NECK AND PROSTATECTOMY

AN OPERATION SUITABLE FOR ALL TYPES OF NON-MALIGNANT BLADDER NECK OBSTRUCTION

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BEFORE describing operative procedures, it is necessary to consider the mode of healing of the prostatic fossa and of the bladder neck.

It has been shown by Flocks (1938) and by Berry (1946) that provided a layer of prostatic tissue is left lining the true capsule, rapid healing occurs. Epithelium creeps out from innumerable open prostatic ducts, undergoes metaplasia to transitional epithelium and covers the surface completely within three to four weeks. Healing is thus closely similar to the healing of skin after a split skin graft has been taken from it and as the underlying tissues are provided with early epithelial covering, little scarring and contraction occurs. These observations are of fundamental importance and explain why the prostatic fossa remains open after prostatectomy.

The result of removal of the false capsule can be seen when dealing with the post-operative strictures of the prostatic fossa by endoscopic resection. I have observed repeatedly that in the region of the stricture a ring of dense fibrous tissue has been covered by a thin epithelium only, while in that part of the prostatic cavity which had remained open, there has been a layer of prostatic tissue beneath the covering epithelium. The only reasonable explanation is that loss of the false capsule at the original operation had resulted in exposed fibrous tissue behaving as exposed fibrous tissue always does behave; it had ulcerated, scarred and contracted.

Furthermore, post-operative panendoscopic examinations carried out personally in a number of cases have shown that a trigonal flap sutured down over the "false capsule" does not stay in place. The false capsule epithelializes beneath it. On the other hand, when a flap of trigone is fixed down to a bed devoid of prostatic tissue, then the flap has stayed in place and the smooth surface of trigonal mucosa has been seen to have united nicely edge to edge with the epithelialized false capsule. The false capsule thus behaves as if it were a mucosa, albeit a damaged one, and it should be handled by the surgeon as such.

At the bladder neck the situation is fundamentally different. Prostatic tissue here is a pathological intrusion and when it is stripped away a raw surface of the fibro-muscular tissue is exposed. Healing is delayed and the granulating surface is slowly covered by epithelium, which creeps over it from the edge of bladder mucosa above and from the false capsule below.

It is characteristic of this type of healing that scarring and contraction inevitably follow and the degree of scarring and contraction will depend on the time taken for the raw surface to acquire a complete epithelial covering. The most important factor affecting the healing time will be the width of the raw surface, but infection and diathermy burns will both delay healing and thus increase scarring.

It may be reasonably concluded that in the prostatic fossa, scarring can be prevented by leaving a layer of prostatic tissue lining the true capsule, but the only way in which scarring at the bladder neck may be prevented will be by eliminating the raw surface here, either by excising it or by providing immediate epithelial covering for it.

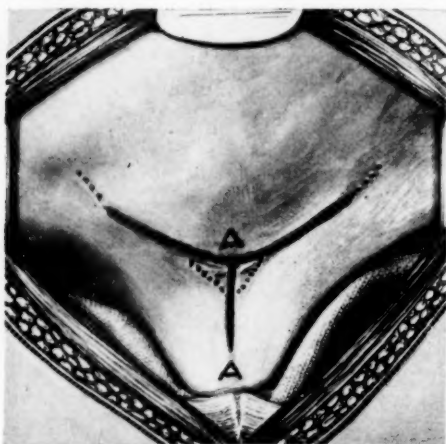


FIG. I. YV-plasty (not now used). Incision: Vertical limb of incision cuts bladder neck. Lateral limbs extend out into bladder wall.

When urinary obstruction is due to a contracted bladder neck, the essential feature to be dealt with is a ring of fibro-muscular tissue beneath the epithelium in this region. It has seemed reasonable to assume that satisfactory and permanent widening of the bladder neck will be attained only by the application to this situation of established surgical principles for the management of subepithelial bands and scars. A review of such principles here would be out of place and it will suffice to say that to sever a band lying beneath a mucosal surface and leave a gaping wound to heal by granulation, as is done when a wedge is taken from the bladder neck, is not in accord with these principles.

With these ideas in mind, the following operative procedures have been evolved.

The operation is described as it is applied to a case of congenital bladder neck dysfunction or to a small fibrous prostate.

Modifications of the procedure entailed by the presence of an adenomatous prostate will be mentioned later.

The approach

The retropubic approach to the prostate as described by Millin (1947) is employed and no detailed description is necessary. Unless a hernia is to be dealt with at the same time, a midline incision is preferred. Veins in the retropubic fat are dealt with by diathermy coagulation. A gauze pack is inserted on each side of the prostatic capsule.



FIG. II. YV-plasty. Closure: The apex of bladder flap may not fit nicely into acute angle in rigid capsular tissue near apex of prostate.

The anterior bladder neck and anterior prostatic capsule

The object of the procedure here is to cut the ring of fibro-muscular tissue at the bladder neck and insert a flap of bladder into the interval between the cut ends.

At first this was done by a simple Y-plasty. This operation was kindly published under the author's name by Reed Nesbit in 1955. The illustrations, Figs. I and II, should make the procedure clear.

The bladder flap however did not always fit nicely into the acute angle in the lower end of the incision in the thick prostatic capsule.

This was suspected to be the cause of a temporary urinary fistula which occurred in one case and the incision has been modified.

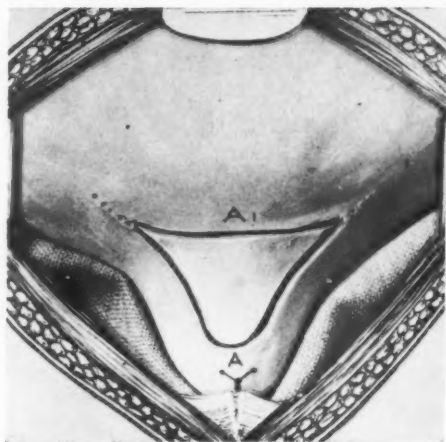


FIG. III. Small fibrous prostate. Incision: Dotted lines show how incision may be extended. Stay suture at prostatic apex. Rounded lower end allows nice approximation of bladder flap (see Fig. XV).

The capsular incision now employed is illustrated in Fig. III. A suture is first placed across the apex of the prostate as far down as possible, catching the upper portion of the pubo-prostatic ligaments. This suture under-runs the dorsal veins of the penis and also acts as a stay suture. If capsular veins are seen lying lateral to this stitch, they are separately under-run and ligated near the prostatic apex. A second stay suture is placed through the bladder wall in the midline just above the bladder neck. (This stitch is not shown in the illustrations.) Cutting deeply with a scalpel, the curved lower part of this incision is made first. It is placed as near the apex of the prostate as is practicable, care being taken to leave sufficient capsule below to provide a secure hold for sutures later. The proximal ends of the incision extend up and laterally through the bladder neck. The flap thus outlined is picked up and cut away by a transverse incision through the bladder wall just above the bladder neck. A portion of the anterior prostatic capsule, together with a wide segment of the anterior sphincter muscle are thus excised, and there is a rounded lower end to the capsular incision.

If the bladder mucosa has not already been opened it will be seen bulging like a balloon into the upper part of the incision. It is picked up and incised. The opening thus made into the bladder should admit two

fingers comfortably and if desired it may be enlarged as indicated by the dotted line in Fig. III.

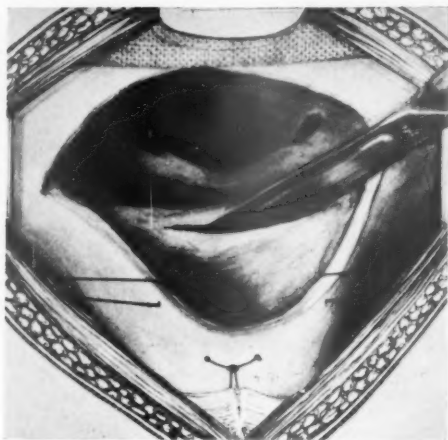


FIG. IV. Small fibrous prostate. Anterior capsule and sphincter have been removed and bladder neck spreader (not shown) inserted. Incision is made along elevated bladder neck. Lateral stay sutures inserted where shown are tied to the Millin retractor and hold up the cut edges of the capsule, thus increasing exposure and decreasing bleeding.

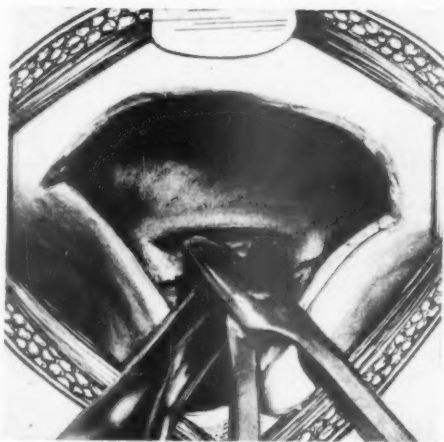


FIG. V. Small fibrous prostate. Trigone (with thick layer of tissue supporting the mucosa) is undermined by blunt scissor dissection.

A finger is inserted into the prostatic urethra. If the prostatic lobes feel small and tough and unlikely to enucleate easily, no attempt is made to enucleate them. They will be dealt with later.

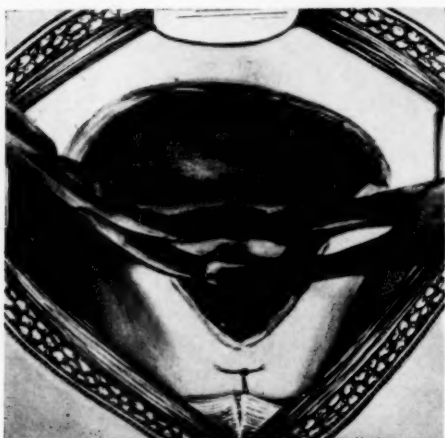


FIG. VI. Small fibrous prostate. The posterior sphincter below the trigone is picked up and a deep wedge removed.



FIG. VII. Small fibrous prostate. Appearance after wedge of posterior sphincter has been removed.

Stay sutures on each side of the prostatic capsule are tied to the arms of the Millin retractor. These increase exposure and diminish bleeding from the capsular edge. A Millin bladder neck spreader is inserted. The ureteric orifices are identified. With a scalpel a deep incision is made along the crest of the ridge of the raised posterior neck of the bladder (Fig. IV). Above the blade of the scalpel will lie the distal portion of the trigone with a good thick layer of fibromuscular tissue including the upper fibres of the sphincter, supporting the mucosa. (It is most important not to leave the fragile mucosa unsupported.) Below the scalpel blade lies the bulk of the posterior sphincter. Into this incision one blade of a Denis Browne forceps is thrust with the other blade in the prostatic urethra, so that between the blades the posterior sphincter is gripped and held up (Fig. V). With a pair of curved scissors, the trigone is cleared away further from the upper aspect of the sphincter (Fig. V) and then a wide and deep wedge or U-shaped piece of the sphincter is removed from beneath the trigone (Fig. VI and VII). Sometimes this wedge is cut so deeply that the vesicles are exposed. No harm results as the defect is later securely covered.

In a congenital dysfunction of the bladder neck, or where the prostate is atrophic, lateral lobes are not disturbed.



FIG. VIII. Small lateral lobes are present (enucleation with finger is not feasible). Trigone has been undermined and sphincter cut away from beneath it (Figs. IV to VII). Tops of lateral lobes are now clearly visible. Lobes are bitten away piece by piece with Denis Browne forceps, leaving a layer of prostatic tissue still lining the capsule.

If lateral lobes are not atrophic, the upper end of each lobe will now show up distinctly. Each lobe, together with its covering mucosa, is bitten away piece by piece (Fig. VIII) with Denis Browne tonsil holding forceps (Fig. IX). This instrument is well suited to the purpose for its dull edges are sharp enough to bite away prostatic tissue without

risk of perforating the capsule. Moreover, since one blade is larger than the other, it is hardly possible to avoid leaving the necessary thin layer of prostatic tissue lining the fibrous capsule. This piecemeal removal is carried out under control of vision and touch and through this incision and with this instrument there is no difficulty in removing each lobe down to its apex. If desired a finger in the rectum can be used to press the prostatic tissue into the bite of the forceps, but this is rarely necessary.

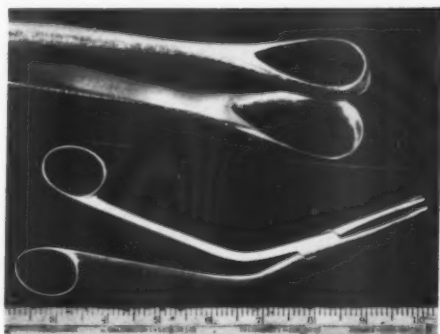


FIG. IX. Denis Browne forceps. Note that one ring is larger than the other.



FIG. X. Small fibrous prostate. The bladder mucosa, together with remaining upper portion of sphincter beneath it, is cut on each side, lateral to the trigone, so that the distal trigone becomes a free flap.



FIG. XI. Photograph taken at operation showing trigonal flap being freed. The left ureteric orifice can be seen medial to the tip of the scissors.



FIG. XII. Small fibrous prostate. Coronal section of model to show the position of postero-lateral incisions which free the trigonal flap. The three sutures which will fix the flap down are shown in place.

Whether lateral lobes are removed or not, the next step is to free the trigonal flap. The flap is drawn down with Denis Browne forceps which allow a secure hold without mucosal damage. With one blade of the scissors in the prostatic fossa and the other blade in the bladder, a short incision is now made lateral to the trigone on each side. Each incision is directed upwards and outwards, parallel to the lateral edge of the trigone, and

well clear of it (Figs. X, XI and XII). The incision cuts through bladder mucosa for not more than half an inch, but it does cut through a thick layer of the upper portion of the sphincter muscle, which has been left supporting the trigone and as these incisions are made the bladder neck will be seen to widen considerably. The distal trigone with a strip of bladder mucosa on each side of it will now fall to lie covering the defect left by removal of the wedge of sphincter posteriorly (Figs XII and Fig. XIV).

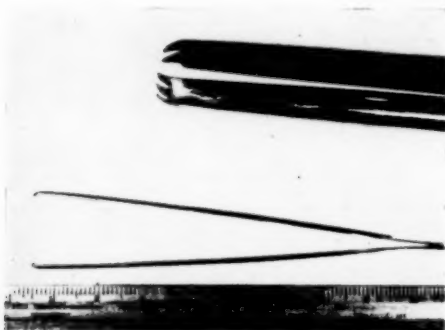


FIG. XIII. Long forceps with catclaw teeth help in picking up true capsule to insert sutures.

The flap is fixed in this position. Usually three interrupted sutures are used and these must get a firm bite of the posterior capsule. This is not always easy and a long pair of dissecting forceps with fine sharp teeth (Fig. XIII) help to pick up the posterior capsule, so that a curved needle can be thrust through it. All three sutures are placed before any are tied.

There is still a raw surface on each side in the region of the postero-lateral incisions which freed the trigone (Fig. XIV). The bladder here is mobile and a suture placed on each side draws the mucosa forward to cover the raw surface. These sutures are placed from bladder through to prostatic fossa taking a very deep bite, and an over-and-over stitch is used, for it is in this region that the prostatic arteries enter the bladder neck. After these sutures are tied, if they have been properly placed, arterial bleeding ceases. The suture thus serves the purpose of the Harris (1928) haemostatic stitch as well as covering

the defect made by the postero-lateral incisions. If bleeding is profuse these sutures are inserted before the trigonal flap is sutured down.



FIG. XIV. Small fibrous prostate. Trigonal flap has been fixed down with three interrupted sutures. These sutures are all placed before any are tied. One postero-lateral suture has been placed. This will close the defect made by the postero-lateral incision and also control arterial bleeding. An over-and-over stitch is inserted and so deeply that it reaches or penetrates the external surface of bladder and prostatic capsule, comprising the branches of the prostatic artery.



FIG. XV. Small fibrous prostate. Photograph at operation showing flap sutured down. Note exposure of prostatic fossa from which prostate has been bitten away piecemeal.

Closure of the anterior incision

A stitch of No. 1 chromic catgut is first placed in the midline anteriorly (Fig. XVI) taking a secure bite of capsule and of bladder wall. This suture is held and is not tied until the closure is completed.

Each half of the anterior incision is now closed by a running catgut suture which begins laterally and progresses towards the midline. Care is taken that the bladder mucosa is caught with each stitch. Finally, the ends of the two running sutures are tied together and further support is provided by tying the two stay sutures together.

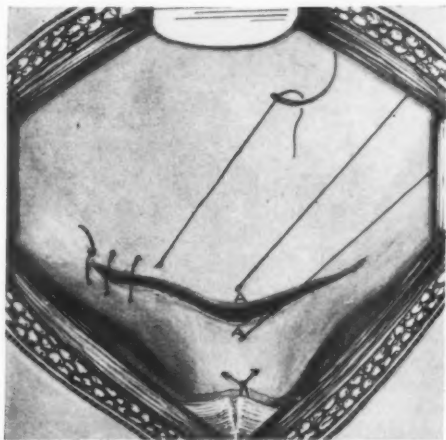


FIG. XVI. Small fibrous prostate. Closure of anterior incision. Note central suture. A continuous suture begins on each side and progresses towards centre where two ends are tied. Bladder mucosa is caught with every stitch.

It will be found that the anterior bladder wall will move readily down into the defect in the prostatic capsule and although it would appear that a short edge of bladder wall has to be approximated to a longer incision in the capsule, this is not in fact the case. The prostatic capsule is fibrous and does not stretch, but the free bladder edge does stretch and so much that sometimes a longer upper edge has to be sewn to a shorter lower one.

When closed it will be found that the incision in the prostatic capsule has opened from a U-shape to almost a straight line, so

that the bladder neck is widened and the dense fibrous tissue of bladder neck is replaced by a pliable bladder wall. Tissues appear to lie nicely in place without tension and the mucosa of the bladder is applied directly to the mucosa of the prostatic urethra, or to false capsule if the prostate has been removed. (Any tension on the suture line could be completely relieved by freeing peritoneum and urachus from the superior surface of the bladder, but this has not been found necessary except in a case of post-operative bladder neck stricture.)

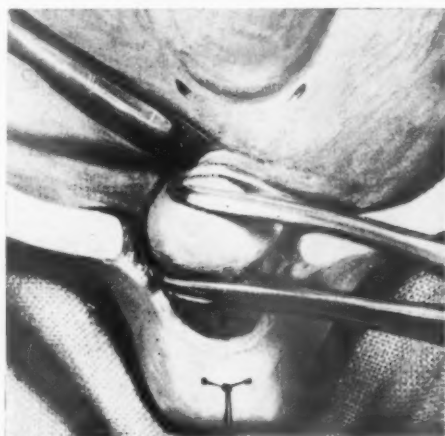


FIG. XVII. A middle lobe is present. Coronal section of model to show middle lobe held forward. Incision at junction of lobe and trigone.

Before closure is completed the prostatic cavity and bladder are sucked clear of clot and a catheter is inserted. If the trigonal flap has been fixed down properly, the catheter will run smoothly into the bladder. In the occasional case where persistent oozing of venous type occurs, a Foley balloon catheter is employed. Traction is necessary as the bladder neck is now so wide that the balloon will not otherwise stay in the prostatic fossa.

Wound closure

The lateral packs are removed and the suture line inspected. Any remaining bleeding point is under-run with fine catgut. A drain is inserted to the retropubic space. The rectus sheath is closed with interrupted sutures of gauge 30 stainless steel wire.

Removal of a small middle lobe

The anterior capsular incision is made as has been described. If a middle lobe is present it will be seen protruding into this incision and it is removed as the next step in the operation.



FIG. XVIII. A middle lobe is present. Coronal section of model. Middle lobe has been dissected free posteriorly and laterally until only remaining attachment is urethra. This is cut with scissors. Posterior sphincter and trigone are then dealt with as described before.

The lobe is drawn forward (Fig. XVII). An incision is made at the junction of the lobe and trigone and the trigonal flap is elevated as before. The ends of the dissecting scissors are now turned against the back of the middle lobe and the plane of the adenoma is found. A snip with scissors on each side frees the lobe laterally. Blunt dissection then progresses distally, until the prostatic urethra is the only attachment. This is severed and the lobe is removed (Fig. XVIII). Removal of the lobe from above down in this way avoids damage to the ejaculatory ducts. The posterior sphincter which lay beneath the lobe is now in view. This is seized and cut away as shown in Fig. VI. It is important that no prostatic tissue be left beneath the trigonal flap, and any retrotrigonal adenoma is removed with the sphincter at this stage.

Postero-lateral incisions in the bladder neck now follow and the operation proceeds as before (Figs. VI to XVI).

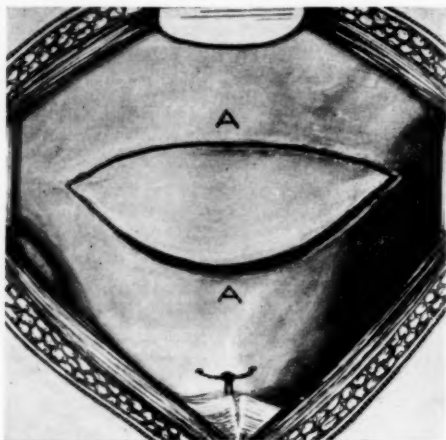


FIG. XIX. The large adenoma. Incision: Note that lower incision is curved more strongly than upper because bladder stretches and capsule does not stretch. Incision gives good exposure and excises anterior segment of internal sphincter.

Large adenomata

For large glands, the incision approaches the shape of an ellipse (Fig. XIX). The anterior bladder neck and upper part of the anterior prostatic capsule are excised. The incision gives excellent exposure and when it is closed, bladder mucosa is applied edge to edge with false capsule. The distal part of the incision has cut deeply into prostatic adenoma so as to show up the line of cleavage between adenoma and false capsule. This plane is opened up all round by blunt dissection with scissors.



FIG. XX. The large adenoma. Sagittal section of model to show method of enucleation. Space "A" was opened first by blunt scissor dissection then with finger. Space "B" was broken into by finger curled round the lobe. Apex is still attached by strip of prostatic urethra.



FIG. XXI. The large adenoma (sagittal section of model). If the apex does not come away readily no force is used. The apex is cut off with scissors and later removed piecemeal with Denis Browne forceps. Gentleness at the apex is essential. Nothing can compensate for damage to the external sphincter.

The lateral lobes are removed separately by combined intra and extra urethral dissection in a manner somewhat similar to that employed by Millin. A finger is inserted into the prostatic urethra and brought forward through the anterior raphe so that the two lobes are separated in front. On each side the plane between adenoma and false capsule, which has already been opened up by scissor dissection, is extended further with a finger. Now from within the urethra firm pressure is made laterally just behind the bulge of each lobe and the prostatic urethra splits longitudinally (Fig. XX) and by working first inside the urethra and then outside the adenoma, the apex of each lobe is freed. If the urethra near the apex does not tear across easily, it is cut across with scissors. If the apex or one or other side does not come free easily, no force is used, but the lobe itself is cut across as far down as possible with scissors (Fig. XXI) and remaining apical tissue is later removed piecemeal with Denis Browne forceps. Gentleness at the apex of the gland is essential in order to avoid damage to the external sphincter, the worst accident in prostatic surgery. Having been freed, the apex of each lateral lobe is seized and lifted up through the capsular incision. By applying traction and with a finger beneath it, it is dissected out and delivered. Its attachment at the bladder neck is finally cut with scissors. At this stage a Millin bladder neck spreader is inserted and there is seen a central ribbon of urethra in the prostatic fossa spreading out

proximally to cover the bladder neck or middle lobe (Fig. XXII).

A middle lobe will next be removed from above down, the prostatic urethra being finally cut across at about the point "X" in Fig. XXII.

The rest of the procedure then follows the lines already described, and differs only in such details as are imposed by distorted anatomy. In a very large gland with retrotrigonal extension for instance, a formal trigonal flap may be redundant.

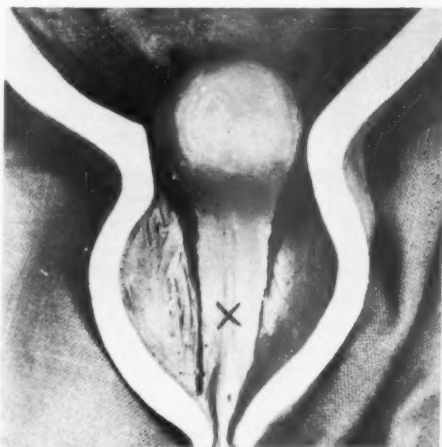


FIG. XXII. The large adenoma (coronal section of model). Section of model showing appearance after removal of lateral lobes. Middle lobe and a strip of urethra remain. Middle lobe will now be removed from above down as shown in Figs. XVI and XVII and prostatic urethra will be cut across somewhere about "X," the proximal portion being removed with underlying middle lobe. The remainder of the operation then follows the plan already described.

Notes on technique

Diathermy is used to control bleeding only until the prostatic capsule is exposed. For control of bleeding within the prostatic cavity, transfixion ligatures are used. Diathermy burns in this region are not only liable to be followed by later secondary haemorrhage, but will also delay epithelialization.

A two-needle holder technique with a curved round bodied needle is preferred and presents no great difficulties. Boomerang

needles have cutting edges and those available here do too much damage and are liable to cause bleeding.

Operating time has been about one hour.

Post-operative care

The wound drain is removed forty-eight hours after operation. As a routine the catheter is removed within forty-eight hours, unless clots are present in the urine, and in a very few cases has it remained in place for more than four days. Patients are usually out of bed on the third or fourth day. Antibiotics are given in all cases until twenty-four hours after the catheter has been removed. Penicillin and streptomycin are used except when culture of the urine has demonstrated the presence of an organism sensitive to some other antibiotic.

had a transvesical operation at the time of a diverticulectomy and one had a radical prostatectomy for a hard gland which was reported upon as showing chronic inflammatory changes in an adenoma. Other than these the series is consecutive and includes all patients referred for surgery during this period.

The public hospital series is a miscellaneous group and includes patients referred by other surgical units who themselves regularly carry out the operation of prostatectomy, and this group has thus been subject to adverse selection.

Deaths

In the private series the death was due to senile dementia which became worse after

BLADDER NECK OBSTRUCTION — (NON-MALIGNANT)

Open Operation with Plastic Enlargement of Bladder Neck — 160 Consecutive Cases from 1/1/55 to 30/6/57

	Private		Public	
	No. of Cases	Deaths	No. of Cases	Deaths
Large prostate (enucleated)	102	1	18	1
Small prostate (not enucleated)	27	—	9	1
Congenital dysfunction			2	—
Late post-prostatectomy obstruction			2	—
Total:	129	1	31	2
<i>Complications</i>				
Urinary leakage Nil				
Incontinence Nil				
Transurethral resection (1/1/55 to 30/6/57)	8	—	18	1

Results

These are shown in the table. Cases have been followed up three months after surgery.

The series operated upon in private practice has been of course subject to the favourable selection of economic circumstances. During this time there were eight cases submitted to transurethral resection, one patient

operation. The patient died some weeks later with pneumonia as a terminal event. In the public hospital series one death resulted from multiple thrombosis and a pulmonary embolus in a patient with a positive Wassermann reaction. The other death is recorded as being due to "broncho-pneumonia" in a patient with congestive cardiac failure, but post-mortem examination was not performed.

Comments

In general the operation described does not appear to have increased risk in terms of either morbidity or mortality.

In particular excision of the anterior bladder neck has not once in 160 consecutive cases been followed by urinary leakage, in spite of early removal of the catheter.

A low mortality in a small series such as this means little; and the operation is only one of many factors which affect the patient's safety. A brief digression on management outside the operating theatre seems pertinent here.

Pre-operative intravenous pyelography is carried out as a routine and cystoscopy has been performed a day or two before operation. Cystoscopy on the table immediately before surgery can give rise to an embarrassing situation if a diverticulum or a carcinoma is discovered.

In this series not one case has been operated upon as an emergency. For retention of urine an inlying Foley catheter has been used and catheter drainage continued for as long as the patient's general condition could be improved by waiting. For overflow retention gravity decompression was employed. Repeated urinary cultures with sensitivity tests to antibiotics were carried out whenever an inlying catheter was in place to enable immediate effective therapy of any pyrexial episode.

A large minority of patients requiring prostatectomy are suffering from another serious disease and it is the discovery and care of this other condition which often decides the outcome. For instance, even in the presence of acute retention, patients in congestive cardiac failure are not operated upon until oedema has been eliminated with mercurial diuretics, together with other appropriate treatment, chronic bronchitics are taught to breathe and to cough by a physiotherapist, and all patients with a history of peptic ulcer have a Ryles tube passed into their stomach before operation and a milk and "Amphogel" drip is continued until they can again take food orally. These examples are only three among the many serious co-existing diseases frequently encountered in this age group.

After operation any tenderness in the calf of the leg is regarded as due to venous thrombosis and the patient is treated with "Dindevan" at once. Prostatectomy is no contraindication to the use of anticoagulants. With prothrombin levels ranging between 15 per cent. and 25 per cent., risk of bleeding appears to be slight and it is rarely that the treatment has had to be discontinued because of haemorrhage.

One of the objects of this procedure has been to prevent post-operative stricture. The fibro-muscular ring of the bladder neck is severed in several places and partially excised. The prostatic cavity and bladder neck are converted into a wide open epithelialized funnel and round the rim of this funnel the suture line is not circular, but is staggered. Late post-operative stenosis should not occur but many years must pass before it can be known whether this complication has been prevented.

Treatment of post-operative strictures of the bladder neck and prostatic cavity

Two cases only of late post-prostatectomy obstruction are listed in the table as having been treated by open operation and two more cases have been operated upon since June, 1957. Other cases have been treated by transurethral resection.

The tentative opinion held at present is that these strictures fall into three groups. Firstly, cases in which the prostatic cavity is wide open and there is a short or diaphragm-like stricture at the neck of the bladder. In such cases the resectoscope can give a very wide bladder neck with a narrow raw surface. The procedure is quick and easy and in most cases subsequent scarring will probably not be sufficient to again cause obstruction and even should this occur, open surgery is still feasible.

There is a second type in which the lower part of the prostatic cavity is open, but there is a long and dense stricture at the neck of the bladder. Transurethral resection can only cause another and probably even denser scar, since it leaves a wide burned raw surface. It is in four cases of this type that the operative procedure described has been employed. Immediate results seem satisfactory, but exposure and access are difficult, especially if a

retropubic approach has been used for the first operation and the operation is not one to be lightly undertaken.

In a third type of case stricturing involves the whole prostatic cavity and the external sphincter may also have been damaged. (At the original operation the prostate had presumably been removed against the plane of the true capsule.) Section of the scar postero-laterally on each side with the resectoscope and then intermittent dilatation is an unsatisfactory but safe solution. It would probably be possible to bring down bladder wall to membranous urethra in front, if the pubo-prostatic ligaments were sectioned, but this has not been tried, as it seems likely to carry some risk of incontinence.

In all cases careful assessment with a panendoscope is essential before considering surgery.

Transurethral resection

The 26 cases shown in the table are not analyzed in detail here. Indications have included retention of urine following abdominoperineal resection of the rectum, some types of late post-prostatectomy obstruction at the bladder neck, mental derangement where it was thought the patient would interfere with an abdominal wound, and a few cases with small glands where expectation of life was reckoned in months rather than years.

With increasing experience of the open operation, transurethral resection has been carried out less and less frequently. The objections to endoscopic resection are two. Firstly, even in the best hands a few patients get severe and troublesome urethral strictures and, secondly, out of the very nature of the procedure, all cases are left with a raw burned surface to ulcerate and scar at the neck of the bladder.

Conclusion

In the case of the large adenomata many operations in current use give good results and indeed the procedure described does not differ greatly from that employed by many surgeons. However, excision of the anterior bladder neck does give better exposure than does a transverse capsular incision. The postero-lateral incisions which free the trigonal flap facilitate placement of sutures

which do control arterial bleeding, and it is believed that elimination of the raw surface in the region of the bladder neck has paid dividends in the form of a smoother and more rapid convalescence; but this latter is an impression and the impressions of a surgeon concerning his own cases are notoriously unreliable.

For cases of contracted or spastic bladder neck, and for small glands which will not enucleate, there has not been available any really satisfactory operative procedure.

In this group of cases the operation described is technically pleasing to do since tissues can be handled gently under full vision and results so far have been good. The requirements of a satisfactory operative procedure appear to have been met.

Summary

The mode of healing of the post-operative prostatic cavity and of the bladder neck have been considered. It is noted that the "false capsule" of the prostate behaves as if it were an abraded mucosa.

It is concluded that to obtain rapid healing and to prevent later scar contraction, it is necessary in the prostatic fossa to leave a layer of prostatic tissue lining the true capsule; at the bladder neck it is necessary to eliminate the raw surface either by excising it or by providing immediate epithelial covering for it.

It is suggested that a contracted bladder neck can be permanently widened only by the application of old established principles of plastic surgery.

An open operative technique is described suitable for the management of all types of bladder neck obstruction, including the small fibrous prostate and the congenital bladder neck dysfunction.

In brief the operation entails excision of the upper portion of the anterior prostatic capsule together with the anterior sphincteric tissue at the bladder neck. At the end of the operation the excised tissue is replaced by pliable bladder wall, together with its covering mucosa.

This incision provides what is probably the best possible exposure of the prostate and

prostatic cavity and also results in widening of the bladder neck with the elimination of any raw surface in this region.

Posteriorly the internal sphincter is cut away beneath and below the trigone and the raw surface is then covered by a trigonal flap.

Postero-lateral incisions which free the flap at the same time widen the bladder neck still further, and also allow placement of sutures, which stop arterial bleeding.

The prostate is removed by finger enucleation if it is adenomatous. If it is of small fibrous type it is removed piecemeal with Denis Browne tonsil holding forceps. The exposure allows this to be done readily with full control by vision and touch.

The final result is the conversion of the prostatic cavity into a wide open epithelialized funnel. One hundred and sixty consecutive cases are reported with three deaths. No case of post-operative urinary leakage occurred in these series.

REFERENCES

- BERRY, N. E. and MILLER, J. (1946), *J. Urol. (Baltimore)*, vol. 56, page 223.
FLOCKS, R. H. (1938), *J. Urol. (Baltimore)*, vol. 40, page 209.
HARRIS, S. H. (1928), *J. Coll. Surg. Aust.*, vol. 1, page 65.
MILLIN, T. (1947), "Retropubic Urinary Surgery." Edinburgh, E. & S. Livingstone Ltd.
NESBIT, R. M. and CRANSHAW, W. B. (1955), *J. Urol. (Baltimore)*, vol. 78, page 516.

CARCINOMA OF THE RECTUM AND ANTERIOR RESECTION

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MY subject is perhaps appropriate at the present time, for recently there have been a number of reviews from different centres on the results of treatment of carcinoma of the rectum and, further, because the operation of anterior resection—or any similar operation aiming at the radical restorative resection of a rectal growth—has now been accorded a definite place in treatment. The operation has had a varied career, being in turn advocated, despised, rehabilitated and now in frequent use.

The operative treatment of any growth is based on the pathology of its spread and though as much or more has been written on this aspect of rectal cancer as any other growth, and though it is widely known, I should like to refer to some of its salient features.

LYMPHATIC DRAINAGE

At the level of the peritoneal reflection off the front of the rectum there is a change in its lymphatic drainage. In the upper rectum the lymphatics run with the inferior mesenteric vessels to the aortic nodes: below the peritoneal reflection they also pass to lymph nodes on the side walls of the pelvis and this wider lymphatic field, not contained in a peritoneal wrapping like the lymphatics of the upper rectum and more difficult to remove efficiently, is believed to be one reason why a growth of the lower part of the rectum has a worse prognosis. It has been shown by many workers that it is rare to find a retrograde or downward spread of cancer cells more than 5 cm. beyond a growth, except in advanced cases where the upper nodes are blocked by growth. Growths of the upper part of the rectum, more than 5 cm. above the floor of the pouch of Douglas, are therefore not likely to involve this lateral lymphatic field. Dissection of the lateral walls of the pelvis for rectal cancer is an operative procedure not yet sufficiently established to provide us with much direct evidence, but when the lateral pelvic glands are removed for low rectal growths they not infrequently contain metas-

tases and, in addition, there is the indirect evidence in the increased frequency of local recurrence for growths situated below the peritoneal reflection treated by combined excision. Gilchrist and David (1947) gave a five-year survival rate after abdominoperineal excision in cases with lymph gland involvement ("C" cases); of 51 per cent. for growths above and 37 per cent. for those below. There was a local recurrence rate in the same group of 23 per cent. for low growths and only 3.6 per cent. for high. It therefore seems reasonable to clear the lateral pelvic walls for low rectal growths, since this procedure does not seem to increase the hazards of the operation and, further, it seems unlikely that this particular lymphatic field will be infected by growths lying 5 cm. above the peritoneal reflection in the pouch of Douglas.

The field of lymphatic clearance in rectal cancer may also be widened by the "high tie" ligation of the inferior mesenteric artery flush to its origin from the aorta and the subsequent removal of some additional lymph nodes at that site. It is suggested that this does not increase the risks either of a combined excision or an anterior resection, since the divided sigmoid colon derives a good blood supply from the marginal vessels through the left branch of the middle colic. During the past decade several careful studies of the arterial blood supply of the large bowel have shown the many variations that may occur. In some cases an important part of the blood supply to the splenic flexure is derived from an accessory branch, passing directly to that region from just below the origin of the inferior mesenteric artery and occasionally in a common trunk with the left colic. When this artery is present the left branch of the middle colic may be small and high ligation in such cases might compromise the viability of the divided sigmoid. Even when this branch is not present, the preservation of the left colic artery is an assurance of a good blood supply to the divided sigmoid colon though in doubtful cases this may

be countered by more frequent mobilization of the splenic flexure and the possible removal of more colon. It could be said that in certain "C" cases of rectal cancer removal of another inch of tissue might make the difference between complete and incomplete removal. The number of cases where this might apply is probably small and in these advanced cases spread by other routes is probably of more importance. I am myself only an occasional ligater at high level for rectal cancer and I do not feel that at present we have sufficient evidence to say that the possible advantage justifies the slight risk.

I suppose that we all subscribe to the principle that operation for cancer should, in general, be as radical as possible but it is interesting to compare these attempts to extend the removal of the lymphatic field in rectal cancer with the view that radical mastectomy in breast cancer has not justified itself and that removal of involved axillary nodes may do more harm than good. Post-operative prognosis in cancer surgery may depend more on the biology of the growth and the reaction of the host than on an extensive resection but it seems reasonable to remove operable lymphatic nodes if this does not increase the mortality rate of the operation. The work of Dukes on lymphatic spread, when associated with the grading of Broders, has proved to be of value in post-operative prognosis but it is difficult to assess the direct lethal effect of lymphatic spread and other factors which may keep pace with it may be more important. In a recent survey of 92 cases of rectal cancer dying from metastases after resection (Muir, 1956), there was evidence of extensive lymphatic spread in only 5.5 per cent., but since not all these patients were submitted to autopsy this figure probably under-estimates the frequency.

VENOUS SPREAD

Brown and Warren (1938), Dukes (1944), Sunderland (1949) and others have stressed the importance of venous invasion by growth in excised specimens of carcinoma of the rectum and colon. Barringer, Dockerty, Waugh and Bagen (1954), and later Madison, Dockerty and Waugh (1954), injected the veins of excised growths with radio-opaque material and after X-raying the specimen, submitted to microscopic examination

points of obstruction or distortion in the venous pattern. Both accounts gave a very high percentage of venous invasion: 38 per cent. (Barringer) and 42.9 per cent. (Madison). If we accept that some areas may have been missed, then it would seem probable that at the time of resection almost half the large bowel growths already have venous invasion. While this does not mean that they will necessarily develop metastases, it has been shown that the post-operative prognosis is worse. Sunderland (1949) found that the five-year survival rate was three times better in cases with lymph gland involvement alone than when venous invasion was also present. Venous invasion is more commonly found in advanced growths and in those of high malignancy but it also occurs in others. Barringer (1954) considered that nearly half the patients whose growths had been excised with hope of cure finally died from hepatic and other blood borne visceral metastases. In the group of 92 cases of rectal cancer dying from recurrence after resection which I surveyed, 50.5 per cent. showed liver metastases, 13.2 per cent. pulmonary, 33 per cent. peritoneal, 5.5 per cent. in the central nervous system and 17.6 per cent. in the skeleton. Both metastases in the central nervous system and in the skeleton are more common with rectal than colonic growths, no doubt because of the easier access to the para vertebral venous system. Cerebral metastases are more common with bronchial carcinoma than with any other growth but they also occur in rectal cancer and there were five known cases in this group. In two of these, and they were both "A" cases, growths involving only the mucous membrane at the time of resection, a long period of five and eight years intervened before the metastases appeared but at the National Hospital for Nervous Diseases, Queen's Square, there have been patients where the first symptom was due to a cerebral metastasis and the rectal growth was discovered on routine examination. We know that blood borne metastases are more common in an advanced growth or one of high malignancy. Venous invasion is more commonly found in growths of the lower than in the upper rectum. Apart from these factors blood borne metastases are as capricious as they are tragic. Once shed they may flourish, they may die or they may remain in suspended animation for years until perhaps some altered factor in their environment

stimulates them to fresh growth. For the present we are not yet on terms with this problem and there is no evidence that increasing the scope of resections could influence it in any way.

PERITONEAL SPREAD

In this series about one-third of patients dying from recurrence after resection of a rectal growth showed evidence of peritoneal involvement, whether generalized or confined to the site from which the growth had been removed, and I am not now referring to recurrence in the bowel at the anastomotic site. This involvement of the peritoneal cavity almost certainly occurred through direct breaching of the serous coat of the bowel by the growth. This peritoneal breaching is not confined to "C" growths: it is not uncommon to find it unassociated with lymph node involvement and its presence in an excised growth makes prognosis uncertain.

It may be questioned whether this depressing information on recurrence is of real value and what significance it is to us as surgeons. The growth and spread of cancer is difficult to foretell, depending on cell and host. Some of its routes of spread are quite beyond our powers as surgeons to combat and surely this should induce in us an attitude that avoids rigid rules in treatment and realises that when compromise is necessary in cancer surgery it is not a council of defeatism but simply common sense.

THE CHOICE OF OPERATION IN RECTAL CANCER

The standard operation in the treatment of rectal cancer is some form of combined excision, whether it is performed by the abdomino-perineal, the perineo-abdominal or the synchronous combined routes. In perhaps one-third of the cases the growth is suitable for an interior resection or some similar restorative operation; in a very small number total pelvic viscerectomy is required and justified and, finally, there are the operations of perineal excision and Hartmann's operation (abdominal resection) which may be useful in frail patients. Surgeons interested in particular operations tend to find more frequent occasions for their use and my personal experience has been to find that the percentage of cases suitable for anterior resection

steadily rises; out of the last 307 resections for rectal and recto-sigmoid cancer, 114 or 37.1 per cent. have been submitted to anterior resection.

Resections for rectal and recto-sigmoid cancer

307 cases — 1945/1957

Combined excision — —	179	12 deaths	6.7%
Anterior resection — —	114	1 death	.9%
Total pelvic viscerectomy	6	2 deaths	
Abdominal resection — —	2		
Perineal resection — —	6	1 death	

Percentage cases anterior resection: 37.1%.

Some centres cite a much higher frequency for restorative resection. Waugh, Block and Cage (1955) from the Mayo Clinic performed some form of restorative resection on 283 out of 444 cases.

Resections for rectal and recto-sigmoid cancer

Mayo Clinic — 444 cases (Waugh, Block and Cage, 1955)

Anterior resection — — — —	135	(30.4%)
Sphincter preserving operation —	148	(33.3%)
Abdomino-perineal — — — —	161	(36.3%)

Percentage cases restorative operation: 63.7%.

While restorative resection may be performed by different methods, I shall consider particularly the operation of anterior resection. If it is to be effective in radical treatment it should possess the following essentials (Muir, 1948, 1952, 1955):

- (1) The inferior mesenteric artery should be ligated at the same site as for a combined excision. The classical site was below the first sigmoid artery but it is probable that ligation is now usually performed immediately below the left colic artery.
- (2) A clear margin of 5 cm. of bowel must be removed below the growth. The lower edge of the growth on sigmoidoscopy should be at least 10 cm. from the anal margin and on laparotomy 5 cm. above the peritoneal reflection in the floor of the pouch of Douglas.
- (3) Sufficient rectal stump should be left to ensure proper continence; 5-6 cm. from the anal margin is desirable. Except when the operation is performed for a growth of the distal sigmoid, when the anastomosis will be

intraperitoneal and lie above the floor of the pouch of Douglas, as much as possible of the rectum should be removed compatible with continence and the dissection carried down to the level of the levator ani. This is essential. Dissection of the lateral pelvic walls can be performed if desired.

- (4) The remaining rectal mucosa should be free from adenomata or they should have been effectively removed.
- (5) The sigmoid colon must reach the rectal stump without strain and with a good blood supply. Mobilization of the descending colon and splenic flexure may be necessary. Diverticulitis or a short sigmoid may make the operation impossible.
- (6) The growth should be early and not of high malignancy as determined by a previous biopsy. Advanced or very malignant growths are more likely to have given rise to retrograde spread.
- (7) In an obese subject with a small pelvis the operation may be very difficult and if it seems likely to lead to an ineffective removal, a combined excision should be performed. In general small growths just palpable at the tip of the finger some 2" to 3" above the cervix or seminal vesicles and well differentiated are ideally suitable for anterior resection but a final decision can only be made on laparotomy.

The young patient with rectal cancer presents a difficult problem. An anterior resection, properly performed, differs only from a combined excision in that it leaves a rectal stump, the levator ani and the fat of the ischio-rectal fossa. The two latter are only involved by direct extension of growth and if this is not present then retention is no disadvantage. The retention of rectal mucosa, however, in a young subject who has already developed a carcinoma in that site is an obvious risk. The tendency to unrestrained epithelial proliferation is present and, in theory, the best solution to this problem would be the total ablation of all large bowel mucosa and the provision of a permanent ileostomy in all such cases. While no one would seriously consider this, except perhaps

in familial polyposis, many would feel that as much as possible of the lower colon should be removed.

Anterior resection as a palliative operation

In patients with a locally operable growth but hepatic metastases it has obvious advantages. However, if the operation is performed on a locally advanced growth recurrence in the pelvic soft tissues may again involve the bowel before the patient's death from liver failure.

Pre-operative treatment

This entails the usual pre-operative assessment of an elderly patient facing a major abdominal operation and in addition preparation aiming at a sterile and empty bowel at operation. I have personally had one case of staphylococcal enteritis which developed forty-eight hours after operation. The patient recovered on intravenous erythromycin but since then I have confined the pre-operative sterilization of the bowel to sulphaphthaldine alone. A preliminary right transverse colostomy will be required if there is any suggestion of obstruction.

Operative details

While either may be used, a long lower paramedian incision on the left side has the advantage of easier access to the splenic flexure should this require mobilization. After fully mobilizing the iliac and sigmoid colon the branches of the inferior mesenteric artery are displayed and ligation of the main artery performed below the left colic branch. After the peritoneal division the rectum is stripped forwards from the sacral hollow and freed as for an abdomino-perineal excision. Though particularly indicated for a low growth there are advantages in some form of lateral clearance as a routine in anterior resection, since it prevents any tendency to "core out" the rectum. The ureter should be mobilized for three or four inches downwards from the pelvic brim and in the female it is an advantage to divide the ovarian vessels. The common iliac artery is now cleared, the clearance extended for a short distance along the external iliac and the tissues are then stripped downwards and inwards, displaying the internal iliac artery in its short course. It is convenient to display the left wall of the pelvis from the right side and vice versa.

An error in judgment through working with the rectum on the stretch may lead the surgeon to divide the bowel below the growth closer than he should, or indeed than he imagines. This will be avoided by a really complete mobilization to the levator ani and by making no final decision as to the type of operation until this mobilization is complete. The upper surface of the levator ani muscles must be clearly seen; in the Trendelenberg position they are convex upwards, and also the actual junction of the muscular coat of the rectum as it passes through the levator hiatus. Posteriorly a good landmark is the ileo-recto-coccygeus muscle, a band of longitudinal muscle fibres passing from the ileo-coccygeus portion of the levator ani to the posterior surface of the rectum. If this is divided the rectum can be stripped still further forwards.

When mobilization is complete, a clamp is applied across the rectum at the chosen site and the rectal stump is then cleansed from the perineum by irrigation through a proctoscope with 1:500 perchloride of mercury. This not only cleanses the bowel lumen but it is hoped that it also destroys any viable cancer cells present in the lumen. There is ample pathological evidence to show that these exist and indeed if the fluid of the wash-out is examined actual particles of growth can sometimes be seen by the naked eye. It is probable that this precaution diminishes the chance of implantation at the suture line. Meanwhile if there has been any oozing from the front of the sacrum the cavity can be sprayed with 10 cc. Thrombin solution (5,000 units).

With the uterus and vagina, prostate and vesicles retracted forwards the rectum is pulled upwards by the clamp, a gauze swab tucked in front of the sacro-coccygeal region and an incision made across the anterior rectal wall below the clamp. The lower cut edge is picked up right and left by two "cobbling" sutures which are held long and assist in keeping the stump in view and limiting its natural eversion. The division of the rectum is now completed by scissors and two further holding sutures inserted on the posterior wall. This small rectal stump obtains its blood supply from the inferior haemorrhoidal vessels, branches from the lower part of the posterior vaginal wall, the

prostate and the pubo-rectalis fibres which invest it closely. Any bleeding points in the para-rectal fat are ligated. A suitable site is selected on the sigmoid, the meso-sigmoid divided to give the required length and the sigmoid is now cut across obliquely, the lumen being enlarged if necessary by extending the incision on the anti-mesenteric border. To avoid the risk of para-colic spread, the sigmoid should not be divided close to the recto-sigmoid junction: if more length is required the splenic flexure should be mobilized. No clamp is used on the end of the sigmoid and after division the lumen to be anastomosed is swabbed out with small swabs soaked in 1:500 perchloride of mercury. A series of catgut mattress sutures is now inserted between the end of the sigmoid in the abdomen and the rectal stump in the pelvis, starting with the mesenteric border of the sigmoid to the right side of the divided rectum. These sutures, through all thicknesses of the bowel wall, turn in the mucous membrane for the posterior part of the anastomoses. They are left long until they are all inserted and the sigmoid is then slipped down the sutures to the rectal stump and the sutures tied. A continuous catgut stitch now starts in the posterior line of the anastomosis and continues round the left side, inverting the mucosa at the corners to end in the midline anteriorly. A similar stitch passes round the right side. Interrupted sutures placed round the anastomosis pull down the peritoneal jacket of the sigmoid to the para-rectal tissues and the sigmoid may also be sutured to the posterior vaginal wall or prostate. Penicillin-sulphathiazole powder is sprayed around the anastomosis, the pelvic peritoneum united around the sigmoid and the abdomen closed. The sacral hollow requires drainage and I think this is best obtained by dependent drainage through a stab drain inserted beside the coccyx and left in for four days.

If at the conclusion of an anterior resection there is any doubt regarding the viability of the anastomosis, a proximal loop colostomy should be performed in the transverse colon.

The after-treatment is similar to that of any major abdominal operation, nothing being given by mouth until there is evidence that peristalsis has been renewed.

RESULTS

Up to the present time I have used the operation of anterior resection on 114 cases of rectal and recto-sigmoid carcinoma, with one death from massive pulmonary embolus on the ninth day. The complications are those common to any major abdominal operation in an elderly patient and in addition pelvic infection, fistulae, stricture, incontinence, urinary infection and recurrent carcinoma at the anastomotic line. It is my impression that elderly patients tolerate this operation better than a combined excision.

Pelvic infection

Serious pelvic infection is an indication for emergency transverse colostomy. It may be associated with separation of part of the anastomotic line, due either to a vascular necrosis of the sigmoid end or rectal stump, or, as occasionally happens, through performing the operation below a loaded colon which has not been properly cleared and which results in scybalous masses being passed through the anastomosis at too early a date. I have had four cases of fistula in this series, two into the vagina and two into the pre-sacral space. An advantage of closing the pelvic peritoneum around the sigmoid is that the anastomotic line is outside the general peritoneal cavity.

Stricture

Initially the anastomotic ring is always smaller than the rectal ampulla, since it is the junction with the sigmoid. In the majority of cases it soon dilates and may be difficult to detect some years later. It may persist as a narrow fibrous ring. I have seen no case requiring dilatation.

I do not myself use any non-absorbable suture material in performing an anterior resection but in spite of this I occasionally see patients with persistent granulations at the anastomotic line. Sometimes the granulation tissue forms small polyps, almost like a fibrous epulis, and raises the suspicion of recurrent carcinoma. No doubt similar changes occur after colonic resections, though we do not have the same opportunities of detecting them.

Incontinence

It is not uncommon for patients to experience some difficulty in rectal control over the

first few post-operative weeks, but this soon passes and I have had no case of permanent incontinence after an anterior resection. The majority finds it necessary to defaecate more frequently than they did and an attack of diarrhoea, tolerable in a normal person, becomes embarrassing since they have lost part of their faecal reservoir.

Urinary difficulties and infection are less common after anterior resection than a combined excision, no doubt due to preservation of the pelvic floor. I think they are rather more common after clearance of the lateral pelvic walls, though I have no statistics to support this.

Local recurrence in the anastomotic line

When local recurrence takes place after an anterior resection for carcinoma of the rectum, exact information is usually forthcoming about the site of origin. The anastomotic line can be felt and seen and kept under post-operative observation and if a recurrence appears, a combined excision can usually be performed allowing the pathologist an opportunity to assess the possible cause for the recurrence. If the operation of anterior resection has done nothing else it has at least drawn our attention to what may happen to an intestinal anastomosis. It may heal and leave hardly a trace; it may form a stricture; it may continue to granulate for weeks or months and, finally, another carcinoma may appear in it.

The following theories have been suggested to explain the recurrence of cancer at the anastomotic site:—

1. Residual cancer cells remaining in the soft tissues or serosa around the bowel and subsequently invading the anastomotic line; retrograde lymphatic and venous spread; marginal lymph spread in the sigmoid and, in general, an operation which has not been sufficiently radical.
2. The stimulus of repair in a pre-cancerous bowel starting a fresh malignant growth.
3. An innocent adenoma or papilloma in the region changing its character and becoming malignant.
4. Cancer cells lying free in the lumen of the bowel becoming implanted on the suture line during the operation.

The first almost certainly explains the recurrence that follows palliative resection of an advanced growth, or where resection has not been sufficiently extensive, but when recurrence follows a wide resection for an early growth it is probably due to implantation of cancer cells whose ability to grow on a granulating surface below a growth has been recognized for many years, with rectal cancer and implantation on a fissure.

From the 114 cases of anterior resection I have had 6 recurrences; in one of these the original operation was performed as a palliative proceeding. In the remaining 5 the recurrence was treated by combined resection of the rectum and lower sigmoid.

There are two points to which attention should be drawn. Every case of anterior resection should be kept under regular periodic examination, for if a recurrence does appear combined excision is well worth while. Of these 5 cases 2 were alive and well seven years and seven and a half years after their combined excision for the anastomotic recurrence.

The second point is that 4 out of these 5 recurrences occurred amongst the first 42 patients, 1 additional occurred amongst the next 18, and there have been none known amongst the remaining 54.

It is the general belief that most of our local recurrences were due to implantation of cancer cells and that irrigation and cleansing of the rectum below the clamp with perchloride of mercury has done much to reduce this risk. Morgan found a recurrence rate at the suture line of 21.4 per cent. in his first 14 cases and only 1.5 per cent. amongst the next 136, a fact which he attributed to the mercuric washout.

Survival rate

I shall consider here the results obtained after surgical treatment of carcinoma of the rectum, first in a series personally assessed; secondly from other centres. I shall make what comparison I can between the results of anterior resection and combined excision.

The first series consists of 417 cases of rectal and recto-sigmoid carcinoma admitted to a group of some 650 general hospital beds over a 10-year period ending in 1955. All cases are included, whether admitted for

radical treatment under the care of a number of different surgeons or for investigation for ascites, hepatomegaly, haemoptysis — due to secondary metastases, or other evidence of metastases (Table 1).

TABLE 1
RECTAL AND RECTO-SIGMOID CARCINOMA
417 CASES

	1945-1950	1950-1955
Number	178	239
Operable	128 (71.9 per cent.)	186 (77.8 per cent.)
(Palliative operations included)		

Perineal Resection	— — 5 (2 deaths)	5 (1 death)
Hartman's Operation	— — — 5	2 (1 death)
Anterior Resection	— — — 33	52
Abdomino-Perineal	— — — 64 (4 deaths)	88 (8 deaths)
Synchronous Combined	— — — 14 (4 deaths)	33 (3 deaths)
Perineo-Abdominal	— — 7	2
Pelvic Exenteration	— — —	4 (1 death)
Operative Mortality	— — — 7.8 per cent.	7.5 per cent.

I would draw your attention first to the fact that the operability rate, though it rose slightly in the second five-year period, was still below 80 per cent. The resectability rate of St. Mark's Hospital for the period 1948-1952 was 92.7 per cent. (Dukes, 1957). These high resectability rates are magnificent but they are not, to my mind, a true picture of carcinoma of the rectum, for special centres do not receive some of the frankly inoperable cases entering general hospital beds. In the group I am considering, between 2.3 per cent. of the patients did not even qualify for surgical exploration. The operative mortality was 7.8-7.5 per cent. In the 1948-1952 period at St. Mark's, already mentioned, it was 6.8 per cent.

The crude five-year survival rate, with no corrections made for deaths due to intercurrent disease, was 78.2 per cent. for "A" cases, 50.5 per cent. for "B" and 28.3 per

cent. for "C," an average crude survival rate of 47.5 per cent. Three patients died of recurrence after five years (Table 2).

TABLE 2

RECTAL AND RECTO-SIGMOID RESECTIONS OR EXCISIONS

Five-year survival rate (5 years elapsed since operation). All operations, palliative resections, included. Four untraced cases not included.

Group	Operation Survivors	Died within 5 Years	Survived 5 Years	Percentage Survival
A	23	5	18	78.2
B	87	43	44	50.5
C	52	37	15	28.8
TOTAL:	162	85	77	47.5
3 patients died of recurrence after 5 years.				

In the 1948-1952 period at St. Mark's, when their resectability rate had reached the high figure of 92.7 per cent., the crude five-year survival rate was only 46.2 per cent. This is hardly surprising, for as resectability rises more advanced cases enter the post-operative survey and hence the five-year survival figures may become worse (Dukes, 1957).

In 1952 Grinnell described the results in a series of colon and rectal cancers treated surgically at the Presbyterian Hospital, New York, over the years 1916-1945. He found that the five-year survival rate for all cases of carcinoma of the rectum admitted to hospital rose from 17.5 per cent. for the period 1916-1920 to 32.7 per cent. for 1936-1940, but in 1941-1945 it dropped again to 28.6 per cent. I could sum up the results in my own series by saying that of every 100 patients admitted to hospital with carcinoma of the rectum (all cases included), 75 will have a resection, 6 will die and of the remaining 69, 33 will survive 5 years.

Table 3 compares the results of cases treated in my series by combined excision and by anterior resection. They show that the results of anterior resection were better than those of combined excision in all groups, A, B and C. Waugh, Block and

Cage (1955) from the Mayo Clinic reviewed a series of 625 cases of rectal cancer treated by three procedures: combined resection, combined resection with sphincter preservation (an operation in which continuity is restored by perineal anastomosis) and anterior resection. They quote a five-year survival rate of 65.6 per cent. for anterior resection, 53 per cent. for combined resection with sphincter preservation and 51.6 per cent. for combined resection. Morgan (1957) gives a five-year survival rate of 46 per cent. for combined excision and 54 per cent. for anterior resection (Table 4).

TABLE 3

FIVE-YEAR SURVIVAL RATE AFTER COMBINED EXCISION

(Five years elapsed since operation)

Group	Operation Survivors	Died in less than 5 Years	Survived 5 Years	Percentage Survival
A	12	4	8	66.6
B	56	28	28	50.0
C	36	28	8	22.2
TOTAL:	104	60	44	42.3

FIVE-YEAR SURVIVAL RATE AFTER ANTERIOR RESECTION

(Five years elapsed since operation)

Group	Operation Survivors	Died in less than 5 Years	Survived 5 Years	Percentage Survival
A	10	1	9	90
B	27	12	15	55.5
C	9	3	6	66.6
TOTAL:	46	16	30	65.2

These figures should not occasion any surprise: they are only to be expected. If radical restorative operations, such as anterior resection, are practised on properly selected cases their results should be better than those of combined excision. It should be chosen for a high rectal growth and we know that however treated this type of growth has

a better prognosis. It should be chosen for an early growth, and this has a better prognosis, and it should be chosen for a growth of low malignancy, again a factor for better prognosis.

TABLE 4

RECTAL AND RECTO-SIGMOID CARCINOMA
Crude 5-Year Survival Rates

	Combined Excision	Anterior Resection
Mayo Clinic	51.6 per cent.	65.6 per cent.
Morgan	46 per cent.	54 per cent.
Muir	42.3 per cent.	65.2 per cent.
Dukes (all cases)	46.2 per cent.	

While I remain an advocate of anterior resection, I do not think we should be unduly influenced by figures. In any hospital where this operation is used it skims off the cream and leaves the worst cases of rectal cancer for the operation of combined excision. However well selected, a patient treated by anterior resection will retain a slight risk — and I believe it to be a slight risk — of recurrence which would not be present had the whole rectum been removed. As against this must be set the fact that blood-borne metastases are unaffected by the type of resection, that there is some advantage in retaining an anal orifice, and that in elderly patients anterior resection has a lower mortality.

Ten years ago the operation of anterior resection was in question and those who used it had to defend themselves against criticism. I believe that the position has now changed and that those who still will *not* use it in any case must settle matters with their conscience and decide whether they are right to withhold it from some of their patients.

REFERENCES

- BARRINGER, P. L., DOCKERTY, M. B., WAUGH, J. M. and BARGEN, J. A. (1954), *Surg. Gynec. Obstet.*, vol. 98, page 62.
- BROWN, C. E. and WARREN, S. (1938), *Surg. Gynec. Obstet.*, vol. 66, page 611.
- DUKES, C. E. (1944), *Proc. roy. Soc. Med.*, vol. 37, page 131.
- (1957), personal communication. Awaiting publication.
- GILCHRIST, R. K. and DAVID, V. C. (1947), *Ann. Surg.*, vol. 126, page 421.
- GRINNELL, R. S. (1953), *Surg. Gynec. Obstet.*, vol. 96, page 31.
- MADISON, M. S., DOCKERTY, M. B. and WAUGH, J. M. (1954), *Surg. Gynec. Obstet.*, vol. 99, page 170.
- MORGAN, C. N. (1957), personal communication. Awaiting publication.
- MUIR, E. G. (1948), *Brit. Med. J.*, vol. 2, page 286.
- (1952), "Surgical Progress." London, Butterworth & Co.
- (1955), *Ann. Roy. Coll. Surg. Engl.*, vol. 17, page 48.
- (1956), Lettsomian Lectures, *Trans. Med. Soc. Lond.*, vol. 72, page 127.
- SUNDERLAND, D. A. (1949), *Cancer*, vol. 2, page 429.
- WAUGH, J. M., BLOCK, M. A. and CAGE, R. P. (1955), *Ann. Surg.*, vol. 142, page 752.

ANEURYSM OF THE ABDOMINAL AORTA

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THE advance of syphilis through Europe in the 16th century was accompanied by an increasing recognition of the occurrence of aneurysm of the aorta. Since then, this condition has been described by many authors who have devoted the greater part of their attention to aneurysm of the thoracic aorta. Saleeby (1938) stated that thoracic aneurysm was 4-10 times more common than abdominal aneurysm and that 90 per cent. of these lesions were syphilitic. In an analysis of 230 aneurysms of the aorta, Cranley (1954) found that 82 per cent. were due to syphilis. Nine-tenths of these syphilitic aneurysms occurred in the thorax; the remainder were situated in the abdominal aorta above the renal arteries. Atherosclerosis had caused 14 per cent. of the aneurysms in this series. One-third of the atherosclerotic aneurysms were in the thorax and two-thirds were in the abdominal aorta below the renal arteries. Blakemore (1947) described 32 aneurysms of the abdominal aorta. Twenty-six of the 27 aneurysms situated below the renal arteries were atherosclerotic. The 5 aneurysms above the renal arteries were all syphilitic.

From these and other published series of cases, it can be seen that syphilitic aneurysms usually occur in the thoracic aorta. When they occur in the abdomen they are commonly situated above the renal arteries. Atherosclerotic aneurysms, on the other hand, occur mainly in the aorta below the renal arteries.

In Australia today syphilis is a rare disease and atherosclerosis is the principal cause of aneurysm of the aorta. Because of this, aneurysm of the thoracic or upper abdominal aorta is uncommon, and most of the aneurysms that are seen are located below the renal arteries.

Estes (1950) investigated the fate of 102 patients who had aneurysms of the abdominal aorta and found that 51 per cent. had died after three years, whilst after five years 81 per cent. were dead. Kampmeier (1936) reviewed

60 patients and found that the majority had died from rupture of the aneurysm within six months of the onset of symptoms.

Clinical features of abdominal aneurysm

Many of the patients with abdominal aneurysm have no symptoms at all, while others may only complain of a throbbing sensation in the abdomen. Pain is the symptom which usually causes them to seek medical advice. This pain, or constant deep-seated ache, is situated in the lumbar spine and lower abdomen. It commonly increases and may become intolerable. Pain which occurs in sudden severe attacks, with partial relief between, is of grave prognostic significance. These attacks start in the back and pass to the front of the abdomen or around the loins, sometimes reaching the testes. This pain is ultimately followed by rupture of the aneurysm, but, unfortunately, rupture is not always preceded by this pain.

The most dramatic symptoms occur when the aneurysm ruptures. The patient suffers a violent pain in the back and abdomen. He may vomit and usually collapses. Some patients die immediately, but the majority recover temporarily. This period has been called the "lucid interval" by Copping (1953). It is probable that the flow of blood from the aorta is stanchied by the rise of pressure in the retroperitoneal tissues. When the peritoneum of the posterior abdominal wall gives way and allows free bleeding into the peritoneal cavity, the patient dies suddenly and painlessly.

An unruptured aneurysm forms a non-tender, pulsating mass in the abdomen, usually above and to the left of the umbilicus. A sinuous dilated aorta in a thin subject can mimic an aneurysm exactly. I have, mistakenly, submitted such a patient to operation.

When the aneurysm is ruptured, the abdominal mass is larger, less clearly defined and usually extends into the left loin.

Because of the hypotension due to exsanguination, the mass is often not pulsatile. A leaking or ruptured aneurysm is tender, but the abdominal wall is not rigid.



FIG. I. Lateral radiograph of an abdomen showing calcified outline of aneurysm of the abdominal aorta and right common iliac artery.

These patients usually show other manifestations of atherosclerosis, such as hypertension, absent ankle pulses, coronary and cerebral arterial disease, auricular fibrillation, cardiac failure, etc.

After rupture, the features of a severe haemorrhage will be obvious.

In unruptured cases the diagnosis rests mainly upon the character of the abdominal mass, but valuable confirmatory evidence may be obtained by abdominal radiography (Fig. I). It is essential that a lateral film be taken as well as an antero-posterior. Fig. II is the antero-posterior film of the abdomen of a 70 year old man who had severe abdominal pain. Because of this film it was suggested that he had a leaking abdominal aneurysm.

At laparotomy he was found to have an internal hernia with small bowel obstruction. The curved calcified shadow had been produced by an extremely tortuous calcified aorta. A lateral film would have shown that there was no anterior bulging of the aortic shadow.



FIG. II. Antero-posterior radiograph of abdomen showing curved calcified shadow produced by tortuous calcified aorta without aneurysm.

It is probable that aortography is neither necessary nor desirable in the diagnosis of aneurysm of the abdominal aorta. It is a procedure that carries some hazard, and the presence of clot in the aneurysm may lead to misinterpretation of the angiogram. Fig. III is an aortogram carried out in a patient with a large aneurysm of the right common iliac artery. The radiologist reported that the calcified ring was not due to an aneurysm. Fig. IV shows the ball of clot which was removed from the aneurysm. The blood was flowing through a channel of normal dimensions.

Indications for operation

When an aneurysm is producing severe pain the patient will usually grasp at any prospect of relief, and may demand operation. If the pain is of the type that suggests that rupture is imminent, then early operation is imperative. If rupture has actually occurred, then only a few minutes may be available in which to start an attempt to repair the situation.

When the patient has no symptoms, the decision is more difficult, and a recommendation for operation can only be based upon the presumption that the aneurysm will rupture in the near future. It is impossible to assess the magnitude of this threat accurately,

but the writings of Estes (1950) and Kampmeier (1936) suggest that it is very great. The lack of symptoms cannot be taken as a guarantee of immunity from rupture. Of Estes' 102 patients, those without symptoms did not have a better survival rate than those with symptoms. In my own series of 15 cases of rupture of aneurysm of the abdominal aorta, 7 had had no symptoms prior to the catastrophe.



FIG. III. Aortogram of patient with large aneurysm of the right common iliac artery. The presence of clot in the aneurysm has prevented the outlining of the lesion by the contrast medium.

From these considerations, it would appear that all aneurysms of the abdominal aorta should be excised unless there is some obvious contraindication. This point of view is strengthened when one examines the low salvage rate in operations performed after rupture. Unfortunately the possibility of rupture can only be removed by submitting elderly patients to a formidable procedure, and in a large series there will be a significant mortality.

I have had to make a decision on this point 24 times. In 15 instances the decision was easy because the aneurysm was already

ruptured. Among the 9 unruptured cases there were two patients who did not have any symptoms. One of these was an 82 years' old woman, and the other was a man in very poor general condition. In both of these instances operation was not recommended. There were only two patients who were classed as "good risks." One had very mild symptoms and the other had pain suggestive of impending rupture. Operation was undertaken in both of these. The first patient did well; the second died of a coronary occlusion six days after operation. The remaining five patients were all in the "bad risk" category for such reasons as angina pectoris, severe hypertension, auricular fibrillation and cardiac failure. These patients were submitted to operation because of intolerable pain or threatened rupture. Two died and three survived (Table 1).

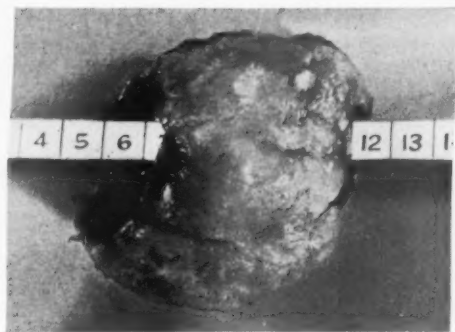


FIG. IV. Ball of laminated clot removed from the aneurysm referred to in Fig. III.

Operation for unruptured aneurysm of the abdominal aorta

Proximal ligation of the aorta, wiring with electrocoagulation, endo-aneurysmorrhaphy, and cellophane wrapping have all been used in an attempt to treat aneurysm of the abdominal aorta. In 1951 Dubost introduced the modern therapy when he carried out the first successful resection of an abdominal aneurysm with arterial homograft replacement. Since then many similar cases have been reported by such writers as Cooley, De Bakey and Creech (1955).

The operation is carried out through a full-length midline incision in the abdomen. The peritoneum of the posterior abdominal wall is opened around the duodeno-jejunal flexure,

along the left side of the root of the mesentery and down into the pelvis. The small bowel is placed in a cellophane pouch which is attached to the right edge of the incision. When the table is tilted to the right, the weight of the small bowel retracts the right-hand side of the wound. The inferior mesenteric vein lies along the left wall of the aneurysm and the left renal vein crosses the aorta above the aneurysm. The ureters may be adherent to the lower part of the aneurysm, particularly if it extends into the iliac arteries. The inferior mesenteric artery is ligated and divided at its origin. Clamps are placed on the aorta above the aneurysm and on both common iliac arteries and 1,250 units of heparin are injected into each common iliac artery below the clamps. The aneurysm is excised and an arterial homograft or a plastic prosthesis is anastomosed to the aorta above and the common iliac arteries below. Before completing the lower suture lines, the clamps on the iliac arteries must be released temporarily to permit the escape of any clot which may lie beyond them.

above the aneurysm and then dissect down between the aneurysm and the inferior vena cava and on between the common iliac arteries and veins. If it should be necessary to leave a piece of aneurysm attached to the vena cava or iliac veins, the arteries can be controlled by external pressure until they are free enough to allow the application of clamps.

The common iliac arteries are often grossly abnormal. The aortic dilatation may continue into them, they may contain separate aneurysms, the walls may have calcified plaques which prevent the passage of suture needles, or there may be small dissections in the arterial wall producing a double lumen. It may be possible to divide the arteries beyond such abnormal areas, but it is desirable to perform the anastomosis proximal to the internal iliac artery unless that vessel is thrombosed.

A dilated artery will be matched with a suitable prosthesis. A false lumen should be oversewn so that a single lumen is available for anastomosis (Fig. V). Large calcified

TABLE 1

ANALYSIS OF 7 OPERATIONS FOR ABDOMINAL ANEURYSMS PRIOR TO RUPTURE

Date	Age	Sex	Indication for Operation	Unfavourable Features	Operation	Result	Remarks
27.2.56	66	M	Symptomless aneurysm.		Nylon Prosthesis	Good	Prosthesis thrombosed one year later.
1.3.56	62	M	Threatened rupture.	Cardiac failure. Fibrillation.	Nylon Prosthesis.	Good.	Patient now alive and well.
9.10.56	64	M	Severe pain.	Angina of effort.	Nylon Prosthesis.	Good.	Patient now alive and well.
29.10.56	53	M	Severe pain.	Blood pressure—240/140.	Nylon Prosthesis.	Good.	Patient now alive and well.
17.12.56	69	M	Severe pain.	Coronary artery disease.	Nylon Prosthesis.	Died.	Died three days after operation. Cardiac failure.
15.4.57	48	M	Severe pain.	Blood pressure—210/150. Renal blood flow interrupted for 80 minutes.	Nylon Prosthesis.	Died.	Dissecting aneurysm and sacular aneurysm. Death due to renal failure.
8.7.57	69	M	Threatened rupture.		Nylon Prosthesis.	Died.	Coronary occlusion seven days after operation.

It is easy to free and clamp the aorta below the renal arteries because the inferior vena cava deviates from the aorta at this level. Difficulty may be experienced when attempting to free the common iliac arteries from the iliac veins, because these vessels are often densely adherent to each other. In this case it is best to divide the aorta between clamps

plaques may be carefully dissected out of the arterial wall. This will leave a false lumen which must be oversewn.

Some unusual difficulties were encountered in a patient who proved to have a true dissecting aneurysm of his abdominal aorta with a superimposed sacular aneurysm.

Case report

In 1951, a 42 years' old man was admitted to hospital because of severe pain in the back and abdomen. His blood pressure was 190/110 mm. of mercury. After nine weeks of intensive investigation he was discharged without a diagnosis having been established.

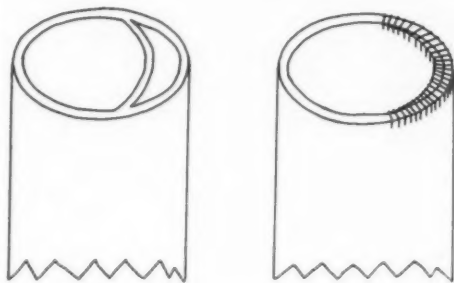


FIG. V. Illustration of the method by which a false lumen in the wall of the common iliac artery may be obliterated to provide a single lumen for anastomosis.

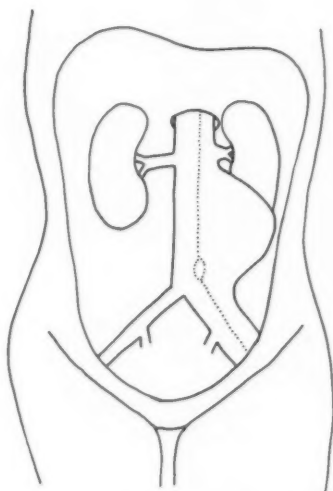


FIG. VI. Patient with true dissection of his abdominal aorta and left common iliac artery and secondary sacular aneurysm of the false lumen of the aorta.

In 1957 he was readmitted to hospital having had increasing pain in the back and abdomen for several months. He also complained of progressive tiredness and some dyspnoea on exertion. His blood pressure was 210/150 mm. of mercury. There was a large pulsatile mass in the abdomen. Despite the unfavourable features in this patient, operation was undertaken because of the severity of his pain.

The abdomen was opened by a full-length midline incision. The small bowel was lifted out of the abdomen and placed in a cellophane bag and the table was tipped slightly to the right. It was seen that there was a very large aneurysm occupying the whole of the abdominal aorta below the renal arteries. It was about 5" in diameter and about 8" in length. The aorta above the renal arteries was at least 2½" in diameter and by palpation of the aorta it was ascertained that this diameter was constant right up to the diaphragm. The left common iliac artery was about 2" in diameter as far down as the bifurcation of the common iliac. The right common iliac artery was of normal diameter. The duodeno-jejunal flexure was mobilized. The mesentery was cut along the left side and the aneurysm exposed. The inferior mesenteric artery was divided and the inferior mesenteric vein, which was adherent to the anterior aspect of the aneurysm, was freed. Both ureters were identified and neither was in a position of danger. The aorta was encircled with a tape above the aneurysm and below the renal arteries. With great difficulty a tape was passed around the left common iliac artery. The difficulty was caused by the close adherence of the left common iliac vein, which was stretched flat over the posterior aspect of the artery. This vessel was torn during dissection and required repair. The right common iliac artery was encircled with a tape quite easily. An attempt was then made to pull up the tape above the aneurysm. This proved to be impossible because of the enlargement of the aorta and the high tension within it. The anaesthetist administered Arfonad and brought the blood pressure down to about 120. Even so, it was not possible to compress the aorta with the tape. A variety of clamps were tried in an attempt to occlude the aorta at this level. None were successful because the width of the aorta was such that the edge of the aorta near the free tips of the clamps could not be compressed. A tape was then passed around the aorta again and it was found that by pulling on the tapes in the line of the clamp, so as to hold the aorta into the jaws of the clamp, and then tying the tape tightly on the handle of the clamp, it was possible to occlude the aorta. The tape on the right common iliac artery was pulled up. It was felt that it probably was not advisable to attempt to clamp the greatly dilated common iliac artery at this stage. Heparin was injected into both common iliac arteries. The aneurysm was then opened and a large laminated clot evacuated. A large laminated clot was pulled out of the left common iliac artery. It was then seen that the aneurysm was, in fact, a dissecting aneurysm of the abdominal aorta with a double lumen (Fig. VI). To the right side there was a normal calibre aorta. To the left and forming the sacular part of the aneurysm was the false track of the dissection. The double lumen passed up through the occluding clamp above and presumably continued at least to the diaphragm. Just above the bifurcation of the aorta there was a point of re-entry of the false track into the normal aorta, so that there was a foramen about 1½" in diameter between the two channels. Inside the true aorta could be seen the mouths of the common iliac arteries. On the left-hand side the false track continued down the left common iliac artery to the bifurcation. It was not possible to determine anything about the artery beyond this point. The right

common iliac artery was unclamped and it was ascertained that there was quite a good return of blood from the leg. It was re-clamped. On the left side the common iliac artery had not been clamped initially and there did not seem to be any return of blood when it was inspected at this stage, but at a later stage it was apparent that there was a good return of blood from the leg on this side. A clamp was placed on this artery also. The aneurysm was then cut across below the upper clamp. Owing to the rather insecure nature of the clamping above, the back edge, that is the edge nearest the tips of the clamp, retracted into the clamp, so that there was not an adequate margin for suturing. In order to get an adequate margin, it was necessary to place a clamp on the aorta above the renal arteries, and bulldog clamps on the renal arteries. The renal arteries were occluded from the general circulation for one hour and twenty minutes. The septum between the true and false tracks of the aorta was cut back so that one continuous rim was made comprising the true lumen on the right and the false lumen on the left and this rim was used for anastomosis to the nylon prosthesis (Fig. VII). This anastomosis was carried out with considerable difficulty because of the poor quality of the aortic wall. When the anastomosis had been completed the clamps were removed from the renal arteries and aorta and the clamp was placed upon the prosthesis below the anastomosis. The greater part of the aneurysm was then cut away. The foramen between the true and false tracks below was then prepared for the lower anastomosis site. The edge of the false track in the left common iliac artery was sewn to the left edge of the foramen, so that this double oversewn edge formed the left-hand side of the rim for anastomosis to the prosthesis. The right-hand side of the rim was formed by the original wall of the aorta. Thus, the blood coming from the prosthesis was directed back into the true aorta just above the bifurcation, and was not allowed to enter the false track of the left common iliac artery. This reformed rim was then anastomosed to the prosthesis below (Fig. VIII). Before completing the anastomosis the clamps on the iliac artery were opened to make sure that there was a good blood flow from below and the clamp on the prosthesis was also opened for a second to make sure that there was no blood clot lying in the prosthesis below the suture line. When the anastomosis was completed and the clamps removed, there was a little loss of blood through the prosthesis but this soon stopped. There was good pulsation in the common iliac arteries below the suture line and it was apparent that there must have been another point of communication between the false and true tracks in the left common iliac artery because the false track of the left common iliac artery distended with blood and pulsated.

His condition immediately after operation was satisfactory and his urinary output was normal. On the second post-operative day he became oliguric but on the fifth post-operative day started to pass large volumes of low specific gravity urine. He died on the seventh day, presumably from renal failure. It was not possible to obtain an autopsy.

Operation for ruptured aneurysm of the abdominal aorta

These patients are usually seen in the "latent period." They have made a partial recovery from their initial collapse and it is essential to gain control of the aorta above the aneurysm before the bleeding starts afresh. This is a true emergency. It is more important to start the operation than to wait for large volumes of blood to be cross-matched. All too often the patient dies suddenly whilst arrangements for operation are being made.

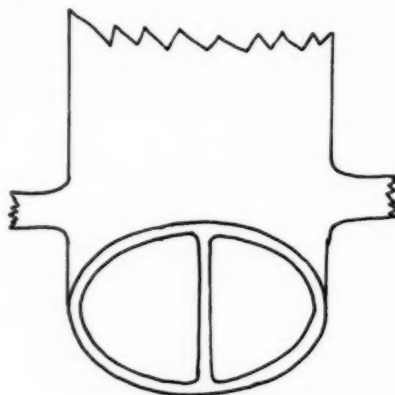


FIG. VII. The double-barrelled lumen of the upper anastomosis site. The external circular rim was used for anastomosis and the transverse septum was left free.

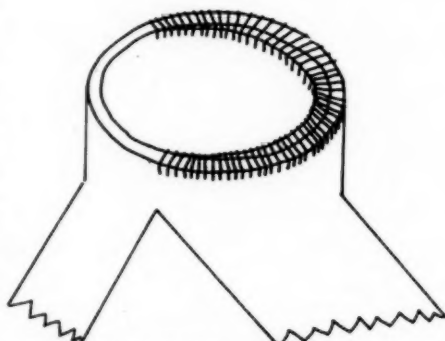


FIG. VIII. The double-barrelled lumen of the left common iliac artery has been oversewn, so that a single lumen remains for an anastomosis below.

When the abdomen is opened the duodeno-jejunal flexure presents at the apex of a plum-coloured dome formed by the aneurysm and

its surrounding blood clot. A hand is passed above this dome to locate the pulsating aorta. The aorta is then compressed against the vertebral column with a suitable instrument. A piece of wood two inches wide and with a slightly concave end is very useful for this purpose. An assistant can now control the aorta while the surgeon proceeds with the operation.

An incision is made through the red blood clot until the white wall of the aneurysm is seen. This plane is followed upwards using finger dissection until the aorta can be felt entering the top of the aneurysm. A clamp or tape is used to control the aorta at this level and the occluding instrument is removed. This is often a blind procedure and the clamp may be placed above the renal arteries. This should be rectified as soon as possible.

Coherence of the iliac arteries and veins may make it difficult to place clamps below the aneurysm. In this case it is best to control these vessels by external pressure until the arteries and veins can be separated by dissection from above. Heparin is injected into the common iliac arteries and the inferior mesenteric artery is ligated and divided. The aneurysm is opened widely, its contents are removed; and the mouths of the lumbar vessels are oversewn. The aneurysm may now be dissected away completely or a strip may be left adherent to the vena cava and iliac veins if it should appear to be advisable. A prosthesis or stored homograft is sewn into position.

Before closing the abdomen the anaesthetist is asked to pass a Miller-Abbott tube into the stomach and the surgeon guides its tip into the duodenum. These patients are liable to develop a severe ileus in the post-operative period.

Occasionally it is possible to repair the aorta more rapidly and simply in extremely poor risk patients.

Case report

A man aged 75 years was admitted to hospital for investigation because his haemoglobin level was 5 gms. He was found to have a symptomless, large abdominal aneurysm. The haemoglobin level was raised to 10 gms. by multiple small transfusions. He was seen in consultation with a view to surgery, but surgery was not advised as he was such a frail, feeble, old man. Several nights later he fell out of

bed, ruptured his aneurysm and became desperately ill. Operation was performed immediately. After opening the abdomen, control of the aorta and common iliac arteries was obtained by compressing these vessels with pieces of wood. The inferior mesenteric artery was ligated and divided. The aneurysm was opened and its contents turned out. The tear in the aneurysm wall was well forward and it was possible to place clamps on the aneurysm, so that an aorta of normal lumen was fashioned out of aneurysm wall, behind the clamps.

The boards which had been compressing the aorta and iliac arteries were now removed, and blood flow was re-established behind the clamps. The aneurysm wall in front of the clamps was cut away leaving a fringe which was oversewn. The clamps were removed. The operation was quickly performed and the circulation to the legs was only interrupted for ten or fifteen minutes. The patient is alive and well eighteen months later. It is unlikely that he would have survived a more extensive operation.

Unfortunately the hole in the aneurysm wall is usually situated too far posteriorly to permit this technique to be used.

The materials used for aortic replacement

Gross introduced stored homograft for use in aortic surgery in 1949. There have been some reports of complications following its use (Brock, 1953; Susman, 1957), but it is probably still the best material available. In the surgery of small arteries, stored homograft or venous autograft are the only materials that should be used, but in the surgery of the aorta, artificial materials give results which are sufficiently satisfactory to justify their use.

The Society for Vascular Surgery recently conducted an enquiry into this problem and the committee headed by Creech (1957) presented the collected results of 256 operations performed by 27 surgeons. They concluded that Dacron and Teflon appeared to give the best results and the worst results were obtained when polyvinyl sponge was used. Polyvinyl sponge is a very easy material to work with, but it would appear that it is probably best to avoid its use.

In the series of patients presented here, stored homograft was used in the earlier cases. Only one of these patients survived operation. His homograft is functioning well two years and five months later. Nylon filter cloth has been used to make prostheses which have been inserted successfully eight times. One of these prostheses thrombosed one year after insertion. The other seven are still patent after periods up to seventeen months. These nylon filter cloth prostheses

are cut and sewn into a wide range of patterns. They are kept in sterile packages, from which a selection is made at the time of operation.

Difficulties associated with the renal arteries

In this series of operations it was necessary to clamp the renal vessels or the aorta above the renal vessels on six occasions.

In two patients with a ruptured aneurysm the aortic clamp was placed by the sense of touch alone as the aorta was hidden in a mass of blood clot. About two hours later it was found that the clamp had been placed above the renal arteries. One of these patients survived, the other died twenty-four hours after operation.

TABLE 2

ANALYSIS OF 15 OPERATIONS FOR RUPTURE OF ANEURYSM OF THE ABDOMINAL AORTA

Date	Age	Sex	Indication for Operation	Unfavourable Features	Operation	Result	Remarks
11.10.54	64	M	Rupture	Pre-Rupture B.P. 210	Homograft replacement	Death	Died eighteen days after operation from intractable ileus.
4.12.54	56	M	Rupture	Thought to be dead when first seen.	Homograft replacement	Death	Died twelve hours after operation. Large lung infarct found at autopsy.
10.3.55	71	M	Rupture	Renal blood flow interrupted for eighty minutes.	Homograft replacement	Good	Patient still alive and well.
20.4.55	67	M	Rupture	Renal blood flow interrupted for twenty-five minutes. Auricular fibrillation.	Homograft replacement.	Death	Died five hours after operation. Autopsy showed extensive coronary disease.
14.7.55	66	M	Rupture		Laparotomy	Death	Patient died as abdomen was being opened.
1.8.55	54	M	Rupture		Homograft replacement	Death	Died four hours after operation. Autopsy showed large embolus in right heart and main pulmonary artery.
13.10.55	76	F	Rupture		Aorta reconstructed from aneurysm wall.	Death	No obvious cause for death found at autopsy.
26.12.55	74	M	Rupture	Pre-rupture hypertension and cardiac failure.	Aorta reconstructed from aneurysm wall.	Death	Died eight days after operation from pulmonary embolus.
28.2.56	75	M	Rupture	Extremely frail patient.	Aorta reconstructed from aneurysm wall.	Good	Patient still alive and well.
5.4.56	59	M	Rupture	Pre-rupture hypertension. L. renal artery clamped for forty-five minutes.	Nylon Prosthesis.	Good	Patient still alive and well.
27.10.56	69	M	Rupture	Pre-operation B.P. 260/145. L. renal artery clamped for forty-five minutes.	Nylon Prosthesis	Good	Transurethral resection of prostate nine days after operation. Bilateral inguinal herniography fifteen days after operation. Patient now alive and well.
14.2.57	77	M	Rupture	Renal blood flow interrupted for two hours.	Nylon Prosthesis	Death	Died twenty-four hours after operation. Autopsy showed extreme atheromatous occlusion of renal arteries.
10.4.57	65	M	Rupture		Nylon Prosthesis	Good	Patient still alive and well.
5.7.57	63	M	Rupture	Ruptured three days prior to operation. Anuria during this period.	Nylon Prosthesis	Death	No obvious cause for death or anuria found at autopsy.
5.8.57	73	M	Rupture		Aorta reconstructed from aneurysm wall.	Good	Patient still alive and well.

In two patients the aneurysm extended up to the left renal artery which, in both instances, was lower than the right. Clamps were placed to occlude the left renal artery and the aorta below the right renal artery. The left kidney was without its blood supply for forty-five minutes in both instances. Both patients survived.

In the patient who had a dissecting aneurysm of the abdominal aorta with a superimposed saccular aneurysm, it was necessary to clamp the aorta above both renal arteries for eighty minutes. This patient died of renal failure seven days later.

The sixth patient had the aorta clamped above the renal arteries for twenty-five minutes whilst his ruptured abdominal aneurysm was replaced with a nylon prosthesis. He died of cardiac failure five hours after operation.

In this small series it can be seen that the results of occlusion of the renal arteries are not uniform. De Bakey, Creech and Morris (1957) discuss this problem. They conclude that the response of the kidneys to ischaemia depends upon "age, pre-existing renal disease, collateral blood supply, individual variations and the like. Periods up to 45 minutes may be safely tolerated, but extension beyond this time is increasingly hazardous. It would also appear that hypothermia of moderate degree . . . cannot be relied upon to provide adequate protection against fatal ischaemic damage to the kidneys when the period of ischaemia extends over 100 minutes."

It is possible that hypothermia might have been useful in the one patient who died of renal failure, but hypothermia carries its own risks and cannot be advocated for routine use.

Results of operation

These patients are often bad subjects for surgery, having widespread atherosclerosis with coronary disease, hypertension, auricular fibrillation and cardiac failure. Many have prostatomegaly, poor renal function and other disabilities common to the elderly.

If the aneurysm has already ruptured, there is not time to consider these adverse factors. When the aneurysm is still unruptured, severe pain, or pain suggestive of

impending rupture, may compel operation despite the presence of such unfavourable features.

Seven patients have been submitted to operation prior to rupture of their aneurysms. Three of these died in the post-operative period. One was the patient with a combined dissecting and saccular aneurysm who died of renal failure. The second was a patient with marked coronary disease, in whom operation was undertaken because he was suffering from intolerable pain in his back and abdomen. He died of cardiac failure three days after operation. The third was a patient with pain suggestive of impending rupture. He appeared to be a "good risk," but he died of an acute coronary occlusion six days after operation (Table 1).

The other four patients are all alive and well. Only one of these could be described as a "good risk" patient. The other three exhibited in turn severe angina of effort, marked hypertension, auricular fibrillation and early cardiac failure. In these patients the operation was undertaken because of severe pain or threatened rupture.

Of the 15 patients upon whom operation was performed following rupture, 6 are now alive after periods varying from five to thirty months (Table 2). It is difficult to imagine a group of patients who would constitute a worse "operative risk" than this. The salvage rate is low and often discouraging, but, in view of the almost certain fatal outcome if untreated, even this small return is worthwhile.

It will be noted that the causes of death, as set out in Tables 1 and 2, are mainly related to the patient's age, the condition of his cardiovascular system and his kidneys. It is probable that increasing experience will lower the operative mortality, but it cannot be anticipated that operations of this magnitude, carried out upon this type of patient, can ever be uniformly successful.

SUMMARY

An account is given of the clinical features and the management of aneurysm of the abdominal aorta. Rupture of the aneurysm is a common terminal event in this condition and it is desirable that operation should be

undertaken before rupture occurs. Unfortunately many of these patients are not suitable for major surgery.

The author's personal series comprises 22 operations for aneurysm of the abdominal aorta. Fifteen of these operations were carried out after the aneurysm had ruptured. Details of operative techniques and results are given.

REFERENCES

- BLAKEMORE, A. H. (1947), *Ann. Surg.*, vol. 126, page 195.
- BROCK, R. C. (1953), *Guy's Hosp. Rep.*, vol. 102, page 204.
- COOLEY, D. A., DE BAKEY, M. E. and CREECH, O. (1955), "Henry Ford Hospital: International Symposium on Cardiovascular Surgery: Proceedings of the Symposium held at the Hospital, Detroit, Michigan, March, 1955." Philadelphia, Saunders, page 448.
- COPPING, G. A. (1953), *J. Amer. med. Ass.*, vol. 151, page 374.
- CRANLEY, J. J., HERRMAN, L. G. and PREUNINGER, R. M. (1954), *Arch Surg. (Chicago)*, vol. 69, page 185.
- CREECH, O., DETERLING, R. A., EDWARDS, S., JULIAN, O. C., LINTON, R. R., SCHUMAKER, H. (1957), *Surgery*, vol. 41, page 62.
- DE BAKEY, M. E., CREECH, O., MORRIS, G. C. (1957), *Ann. Surg.*, vol. 144, page 549.
- DUBOST, C., ALLARY, M. and DECONOMOS, N. (1952), *Arch. Surg. (Chicago)*, vol. 64, page 405.
- ESTES, J. O., Jr. (1950), *Circulation*, vol. 2, page 258.
- GROSS, R. E., BILL, A. H., CONVERSE PIERCE, E. (1949), *Surg. Gynec. Obstet.*, vol. 88, page 689.
- KAMPMEIER, R. H. (1936), *Amer. J. med. Sc.*, vol. 192, page 97.
- SALEEBY, E. R. and MCCARTHY, P. A. (1938), *Penn. med. J.*, vol. 41, page 969.
- SUSMAN, M. P. and PALMER, A. (1957), *Med. J. Aust.*, vol. 1, page 877.

BILIARY TRACT SURGERY IN RETROSPECT*

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THIS discussion on biliary tract surgery is divided into two sections. The first part will concern itself with certain features of the operation; the second with the late results as shown by follow-up.

PART ONE

Mortality

In Table 1 are shown the figures from the unit of the senior author (J.S.) from January, 1951, until 30th June, 1956. The figures include all patients undergoing biliary tract surgery on the unit over this period; both for elective operations, and for those done for acute complications (including patients with acute cholecystitis, ruptured gall-bladders, and those with jaundice). It is not thought that there was any selection of patients, as the acute ones for example were allotted to the unit on the basis of its admitting day being Tuesday.

Grey Turner wrote, probably in about 1940, as the book was published in 1943, that "the mortality rate for cholecystectomy should not exceed 3 per cent, if there were acute complications 5 per cent., and if jaundice was present 10 per cent." The surgeon of the 1950's enjoys advantages not available to the surgeon of the 1930's—the improvement in anaesthesia and clinical pathology, to name just two. It is suggested that Grey Turner's figures are no longer those at which to aim, since experience in this hospital and elsewhere shows that all types of present-day biliary tract surgery for stone can be done with an over-all mortality of 1 per cent., with a lower figure for elective surgery.

The influence of specialist training on mortality

Of all these operations, about 75 per cent. (140 in 180) have been performed by Registrars, assisted in their first and second Registrar (fourth and fifth post-graduate) years by one of us (J.S.) and in their third

Registrar year sometimes assisted, sometimes alone. In these 140 patients one death occurred (0.7 per cent.). It has been suggested that teaching, particularly allowing trainees to perform operations under supervision, raises mortality rates. Experience on this series suggests that the opposite is true; mortality rates have been lowered, not raised. In this regard it is further of interest that there were no deaths in the series attributable to technical errors. Both were due to pneumonia.

Surgery for acute complications

It will be observed that 12 per cent. of the operations were for acute complications. There are two types of acute case: the one in which immediate operation is necessary (for example, ruptured gall-bladder); the other where operation may be either performed or deferred. For want of better terms, these may be described as "acute compulsory" and "acute elective." No "acute elective" operations were done until it was seen that the over-all mortality in the first 100 operations was 1 per cent. (This one death occurred in a man of 85 years with a ruptured gall-bladder and general peritonitis. After recovering from general peritonitis, rupture of his abdomen on the tenth day required resuture. Death was due to bronchopneumonia.) Most of the acute operations are therefore found among the last 80 patients. No elevation of the mortality rate occurred. During this period occasional patients with acute complications have not been subjected to immediate surgery if super-added conditions, as for example, congestive cardiac failure, were present. The cholecystostomies were performed on patients with ruptured gall-bladders whose condition was so parlous that the anaesthetist demanded speed. All three survived, and subsequent cholecystectomy was performed. One of the ruptured gall-bladders occurred in a patient whose previous attack of acute cholecystitis had been treated conservatively. Whilst waiting to be re-admitted, an attack of biliary colic six weeks after discharge from hospital

*Based on a paper presented at a meeting of the New South Wales State Committee held at Royal Newcastle Hospital, August, 1956.

resulted in perforation of Hartmann's pouch within twenty-four hours of onset of the attack. Such an episode is certainly not common, but tends to impress, and can be quoted in favour of immediate as against conservative therapy for acute complications. However, there can be no question that cholecystectomy for acute complications is generally more difficult than elective or "cold" cholecystectomy ("about 10 times" as was said by one observer semi-facetiously, but perhaps not so inaccurately). In addition in acute cases the common duct is often obscured by swelling and a stone in it is therefore the more easily missed. The overall mortality rate will be taken as the indication for continuing the present policy of cholecystectomy for acute complications. Should that rate rise significantly over the present figure of 1 per cent., consideration will have to be given to the advisability of a change of policy.

choledochostomy rate, with 50 per cent. ducts opened showing stones, giving a total of 18 per cent. of all his patients with stones in their bile ducts. Our figures are of the same order. It is also of interest in this regard that Crump (1931) in 1,000 consecutive post-mortem examinations, found that in those subjects with stones in their gall-bladders, "one in four could be said to have a stone in their common bile duct as well." As more than one patient in five undergoing this type of operation has a stone in his bile duct and as approximately two patients in five have to have a choledochostomy to find these stones, this type of operation should be referred to as "biliary tract surgery," not "gall-bladder" surgery. The oft repeated statement that opening the bile duct in association with cholecystectomy increases the mortality rate (doubles it, according to some estimates) has not been borne out in this series.

TABLE 1

AN ANALYSIS OF BILIARY SURGERY PERFORMED ON A SURGICAL UNIT, ROYAL NEWCASTLE HOSPITAL, FROM JANUARY, 1951, TO JUNE, 1956.

Year	Cholecystectomy	Cholecystectomy and choledochostomy	Choledochostomy	Stone in common bile duct	Deaths
1951	12	6	0	4	0
1952	27	5	0	3	1
1953	16	15	0	11	0
1954	17	8	1	6	0
1955	28	15	1	9	1
1956 (½)	15	12	0	5	0
Total	114	61	2	38	2

Acute: 22 (12%).

Cholecystostomies: 3.

Total number of patients: 180.

Hospital mortality: 1 per cent.

Elective mortality: 0 per cent.

Choledochostomy rate

The choledochostomy rate of the series is 35 per cent.; stones were found in 60 per cent. of the ducts opened. This means that in 22 per cent. of all the patients in this series one or more stones were found in the common bile duct. Lahey (1938) has published figures showing a 40 to 50 per cent.

The percentage of patients having stones in their common bile ducts at operation is obviously bound up with the range of the indications for biliary tract surgery. If these indications are extended to include (for example) non-calculous cholecystitis, then a lower percentage of common bile duct stones is likely. The range of the operative indica-

tions should be reflected in the total number of operations performed. The latter number is again dependent on the number of admissions to a hospital, other factors being assumed unaltered. Royal Newcastle Hospital had 7,000 admissions in 1950, over 8,000 in 1952, 12,000 in 1955, at present is admitting at a rate of about 13,000 patients per year. The suggestion is made that by dividing the total operations of any type by the number of admissions in thousands, an operation rate per thousand admissions can be struck. At the moment the rate for biliary tract surgery at Royal Newcastle Hospital is 8.4 per thousand admissions. One large hospital elsewhere recently published its figures, which showed an operation rate of 12.5 per thousand admissions. No suggestion is made that one rate is more desirable than the other, but it is suggested that a lower operation rate should be accompanied by a higher percentage of patients with stones in their common bile ducts. Hence the 22 per cent. of this series is not put forward as necessarily the desirable or correct figure.

APPENDICECTOMY

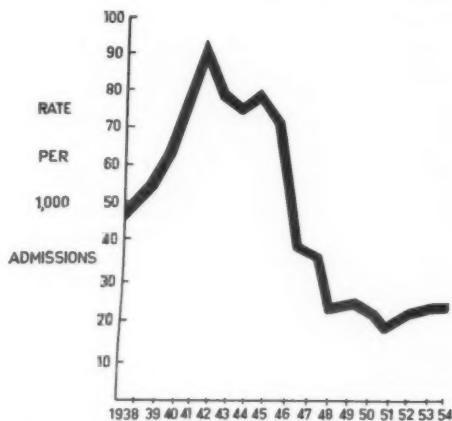


FIG. I. Graph showing the appendicectomy rate per 1,000 admissions to Royal Newcastle Hospital, 1938-1954.

Operation rates

The procedure of relating operation figures to admission figures produces some interesting graphs, as the accompanying one of the 1938-1954 appendicectomy rates of the Royal Newcastle Hospital shows (Fig. I). Fig. II

shows a similar graph for the biliary tract surgery rate per thousand admissions to this hospital from 1939 to 1955. On the same graph can be seen plotted the mortality rate per cent. If the old adage that "practice makes perfect" applied to surgery, then the dotted line should be the mortality rate per cent. It will be observed that almost the inverse of this has actually been the case. No statistical significance is claimed for this calculation; it is simply put forward as an interesting diversion. It is suggested that of itself "practice makes perfect" is a dangerous philosophy when applied to surgery. The only legitimate practice in surgery is that of the specialist trainee (Registrar) performing operations assisted by a senior, so that his mortality rate is kept down to that of his senior during the learning period.

BILIARY TRACT OPERATION RATE PER 1,000 ADMISSIONS

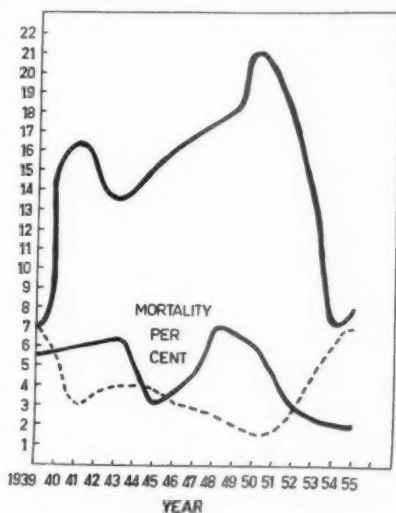


FIG. II. Graph showing the biliary tract operation rate per 1,000 admissions to Royal Newcastle Hospital, 1939-1955. The mortality rate per cent. is also shown. The dotted line indicates the mortality rate to be expected if it were in inverse frequency to the incidence of operation ("practice makes perfect").

PART TWO

Follow-up

To pass now from the near or proximate follow-up to the far, distant, or more definitive results, it is felt that certain features associated with follow-up in general are worth discussion. With increasing experience

of a follow-up clinic, it became obvious that the belief, that the patient who does not voluntarily return to see his surgeon is a satisfied customer, is a delusion.

A follow-up should state the number of patients who were not seen, and discuss the measures taken to trace the patients in order to ensure that a minimum number is lost. Dissatisfaction with the result is one very important reason why patients are lost to follow-up. There are others, as can be seen from the following letter:

Dear Sir,

In reply to your letter of the 25th, I have no intention of keeping those appointments unless compelled by law to do so. I am not an old-age pensioner. I paid for the attention and treatment I received at the hospital, and as for the visits you intend to pay to my home, you will not be welcome, and it sounds very much like the Gestapo to me.

Yours truly,

On one occasion, whilst doing a home visit to trace a patient, one of us (A.C.) was greeted by the lady next door with "Yer won't find 'im — 'e tore off with another woman!" The dead-letter office is helpful up to a point, but appears, understandably enough, not to wish to be involved in such things as divorce cases. It was thought that in a small city such as Newcastle (pop. 200,000), movement of population would not cause many patients to be lost. It appears, however, that this very smallness means that movement right out of a city is more common than in big cities, where it is more often from suburb to suburb. The total of 73 patients lost may appear large, but every effort that seemed possible was used before defeat was admitted in each case. Up to three letters were sent to each patient; then a home visit was undertaken. Special arrangements were made to interview patients at week-ends or at night as their work required. Assistance was obtained from police, the post-office and the Royal Newcastle Hospital Almoner Department. Where patients lived at a great distance, e.g. Taree, Grafton, a letter was written to their own doctor, if possible a former R.M.O. of Royal Newcastle Hospital, explaining to him the features of the investigation and requesting his help. There was an excellent response to these requests, and the doctors concerned must be thanked for their generous co-operation. Table 2 gives the number followed-up and the methods used. It will be observed

that a 93 per cent. follow-up was recorded. The ensuing discussion will therefore concern itself with 951 patients.

TABLE 2

FOLLOW-UP OF BILIARY TRACT SURGERY PERFORMED IN THE ROYAL NEWCASTLE HOSPITAL FROM 1944 to 1955.

Total patients studied — — — —	1,077
Hospital deaths — — — — —	53
Possible follow-up — — — — —	1,024
Lost — — — — —	73
Total followed up — — — — —	951 (93%)
Method:	
In out-patient department — —	751
Home visit — — — — —	130
Local doctor (long distance) —	70

Many words have been spoken and much ink spilt on the subject of the indications for biliary tract surgery. Horowitz (1956) suggested that "calculous cholecystitis, whether symptomless or not, is an indication for remedial surgery" and that "gall-bladder disease should be eradicated before patients reach old age and develop complications such as jaundice, acute inflammation and malignancy. We doubt that there is such a thing as a 'silent' gall-stone. Gall-bladders with gall-stones should be removed before they become vocal, for if they begin to shriek with malignant changes it is often too late." It seems not unfair to state that these views are held by a majority of present-day surgeons, and an attempt has been made to test their soundness.

During the follow-up certain features received special attention, particularly the questions of jaundice, fatty dyspepsia, biliary colic and peptic ulcer.

Jaundice

Jaundice is an easy sign but a tricky symptom, because many patients say "I went yellow" and on being pressed for how long, say "all day." Some "go a nasty yellow colour," which is noticeable to their friends and relatives, but unless the colour lasted several days, these were considered not to have had jaundice.

Fatty dyspepsia

Patients may have fatty dyspepsia for years before getting an attack of biliary colic. An effort was made to find an intermediate stage between fatty dyspepsia and biliary colic by asking many patients leading questions, such as "You had your indigestion for years and no doubt it slowly became worse each time, becoming more and more painful until the agonising attacks started?" The invariable response was "Oh, no, doctor! I had my indigestion for many years and then suddenly one day I got the most awful pain!" The information obtained in this survey suggests that there is no intermediate stage between fatty dyspepsia and biliary colic. The investigation further showed that fatty dyspepsia is about as common in peptic ulcer as in gall-bladder disease, an opinion independently arrived at by the Royal Newcastle Hospital Gastro-enterological Clinic.

and stays for hours unless relieved. The patients usually have some warning of an impending attack—"I know when I'm in for an attack"). Some discomfort, some milder pain, for a few minutes to a few hours warns them that an attack of biliary colic is close, that soon they will be seized with a pain of terrible intensity with, it was discovered, a variety of distributions.

Distribution of pain

The various distributions are shown in Figs. III and IV, but not in order of frequency.

- I. Those which are confined to the epigastrium alone.
- II. The rare type which is confined to the left hypochondrium. During the study only two patients with this type of biliary colic were seen.

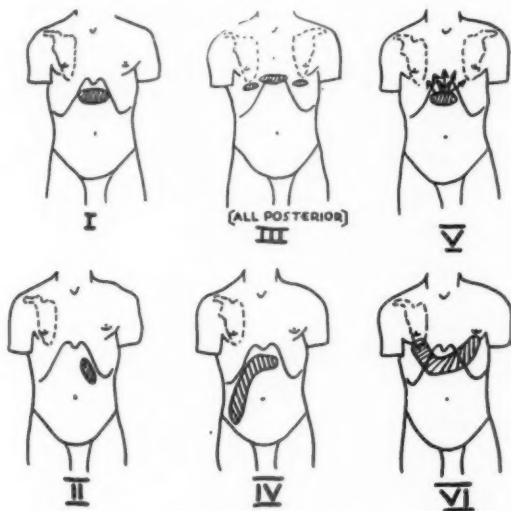


FIG. III. The distribution of biliary colic.

Biliary colic

Biliary colic was studied rather intensively during the follow-up. It was assumed that those patients who had been having attacks of severe pain pre-operatively, and who had been cured by removal of their gall-stones, had had biliary colic. A moment's reflection will remind most surgeons that the pain is not really colic; the pain "hits" the patient

- III. Another rare type which, however, does happen, where the pain is completely posterior.
- IV. The type where the pain begins in the epigastrium, radiates to the right hypochondrium and down towards the right iliac fossa. In acute cases where the greatest point of tenderness is the fundus of the gall-bladder, it is pos-

sible to mistake this type of syndrome for acute appendicitis.

- V. The commonest type of pain of all — where the pain starts in the epigastrium, and, as the patient says, "seems to pass right through me," to emerge at the back between and beneath the shoulder blades.
- VI. The pain which begins in the epigastrium and passes up around the sides of the chest and under both nipples.

It was noted in only two patients. An occasional patient mentioned radiation down the arm, particularly the left, thereby heightening the likeness to coronary pain.

- X. Radiation from the epigastrium to the left hypochondrium.
- XI. The type of pain which the patient states radiates all over his abdomen, so intense is it.

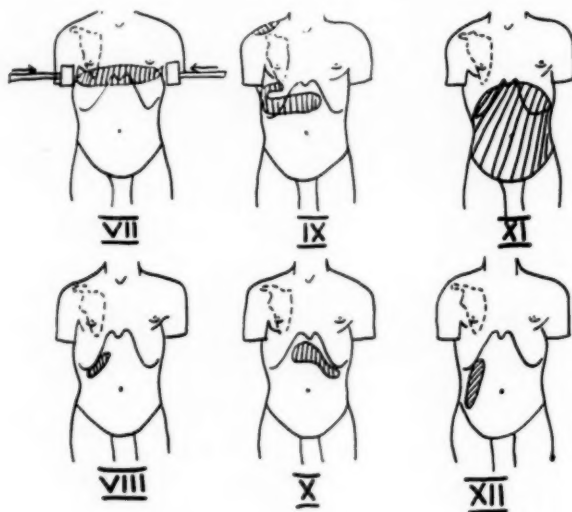


FIG. IV. The distribution of biliary colic.

- VII. A coronary-like pain passing up into and around the chest, associated with a feeling of constriction. This type of pain in one patient in this hospital was mistaken for a long time for either oesophagitis, coronary pain or neurosis. These wrong diagnoses were corrected when the patient became jaundiced after an attack.
- VIII. The pain which is confined to the right hypochondrium.
- IX. The "classical" biliary colic with radiation from the epigastrium to the right hypochondrium and around the trunk to a point beneath the right shoulder blade. In this diagram is also shown the radiation to the phrenic area, which has been described by the Mayo Clinic.
- XII. The pain which starts in the right hypochondrium and passes to the right iliac fossa without there being any midline pain at all.

Details of follow-up

Table 3 sets out the numerical details of the follow-up. Generally it was found that the results did not depend upon the period of follow-up. The period varied; some had had their operation only a year before, others eleven years previously; but if the result was bad after a year, it seemed to be bad after eleven years, and if it was good after a year, it stayed good, as a general rule; there were exceptions, but generally that was true.

Of all the patients, 686 (71 per cent.) had had biliary colic before the operation and 107 had it after the operation. This is a

15 per cent. recurrence rate. However, this result is perhaps better than would appear at first sight. Of these people, the majority had one attack of pain after their operation. The pain was quite indistinguishable from biliary colic, but did not recur. The significance of the phenomenon is unknown to us. Such explanations as small stones running down ducts have been given, but these patients were never jaundiced and had but one attack of classical biliary colic, one week, two weeks, three months after the operation, and then never had another symptom. The second

be recalled that Lahey (1938) described three phases of biliary surgery: first, the removal of the stones from the gall-bladder; secondly, the removal of the gall-bladder plus the stones; thirdly, the removal of the gall-bladder plus the stones, plus the stones in the common bile duct. It has even been suggested that we have now reached a fourth stage. However, no one has as yet perfected the third stage, and stones are still being missed in bile ducts. No solution of this problem appears from this study, but the appreciation of a defect is the first step in its correction.

TABLE 3

FOLLOW-UP OF 951 PATIENTS (93 PER CENT. OF 1,077), 1944-1955

Biliary colic	before	686	71 per cent. of 951
	after	107	15 per cent. recurrence
Jaundice	before	222	23 per cent. of 951
	after	27	12 per cent. recurrence
	after 27	44	4.5 per cent. of 951
	after, not before 17		
+Dyspepsia	before	525	
	after	332	63 per cent. recurrence
Dyspepsia only	before	185	19 per cent. of 951
	after	115	62 per cent. recurrence
Peptic ulcer	before	101	10 per cent. of 951
	after	65	64 per cent. recurrence
	after, ? not before	25	

group, who had post-operative biliary colic and jaundice, are, of course, in a different class. Two hundred and twenty-two, or 23 per cent. of all the patients, had been jaundiced before their operation, and 27, or 12 per cent. of these, had biliary colic and jaundice after the operation. Seventeen patients had biliary colic and jaundice after the operation, but had never had them before operation. In all, the post-operative biliary colic plus jaundice group totalled 44, or 4.5 per cent. of the total 951. This is certainly not the total number of patients who have stones left in their common duct. There are more, because it is known that there are some stones which occur in the bile ducts of patients who do not have jaundice. It will

Fig. V comes from a German source (Wildegans, 1956). It shows an endoscopic instrument recently devised for examining bile ducts. It appeals as a possible answer to this problem. X-ray examination of the biliary passages during operation have provided disappointing results; this is not surprising. There is a wide divergence of opinion expressed in the literature on the value of operative cholangiography and it appears unlikely that radiographic accuracy in diagnosis of calculi could be better than about 90 per cent. As duct calculi are overlooked by the surgeon in about 5 per cent. of cholecystectomies, it would appear that reliance on operative X-ray diagnosis is unlikely to decrease morbidity.

Effect of operation on dyspepsia

By "plus" dyspepsia is meant the dyspepsia that goes with biliary colic, the so-called fatty dyspepsia. This was present in 525 patients before operation, and 332 still had it afterwards, a 63 per cent. recurrence rate. One hundred and eighty-five patients had operations because they had fatty dyspepsia alone. A similar recurrence rate occurred. In 101 patients a peptic ulcer was found before operation, at operation or after operation. This latter group thus constitute the very high proportion of 10 per cent. of the

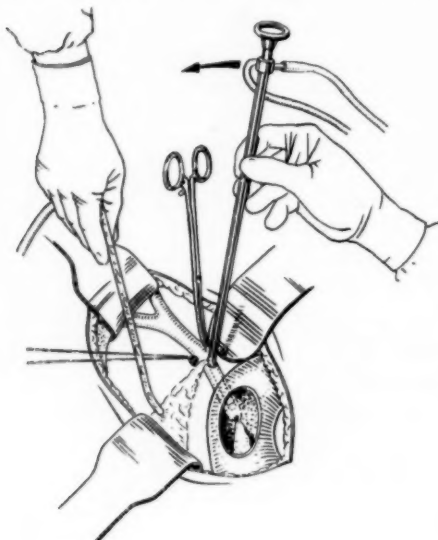


FIG. V. The Wildegans' choledochoscope.

people who had operations. This finding occurs much less frequently in the later than in the earlier years. These peptic ulcer patients also had a 64 per cent. recurrence rate of symptoms. It is difficult to imagine that cholecystectomy does a patient's peptic ulcer more good than would a period of bed rest. It is rather interesting that all the dyspepsias had approximately the same recurrence rate—those with biliary colic 63 per cent., those with dyspepsia alone 62 per cent. and those with peptic ulcer 64 per cent. This raises the question that anyone who has been "sold" an operation likes to think that he received some benefit from it. Special interest was taken in those who had apparently had biliary colic before operation

and a peptic ulcer syndrome after it. When questioned by one of us on this subject, one well-known English gastro-enterologist gave it as his opinion that these were patients who had had an operation for what was thought to be biliary colic when in reality the symptoms were due to peptic ulcer. This was checked very carefully during this survey, and it was thought that 25 patients definitely had classical biliary colic before the operation and a classical peptic ulcer syndrome after it. Many patients were seen whose histories stated that the patient had had severe pains starting in the epigastrium, passing around to the right hypochondrium and up under the shoulder blades. These patients' gall-bladders were removed, but on retake of the pre-operative history at follow-up, many of these patients gave a classical twenty-year pre-operative history of peptic ulcer. Incidentally, all the pre-operative histories were taken again during this survey, for checking.

TABLE 4

THE EFFECT OF CHOLEDOCHOSTOMY RATES OF 19 PER CENT. (SERIES 1) AND OF 35 PER CENT. (SERIES 2) ON FOLLOW-UP

	Before	After
Biliary colic (1)	686	107
(2)	92	10
$X^2 = 1.13$ $p = 0.30$		
Jaundice (1)	222	44
(2)	33	5
$X^2 = 0.30$ $p = 0.58$		
+Dyspepsia (1)	505	332
(2)	72	39
$X^2 = 0.83$ $p = 0.36$		

Effect on varying choledochostomy rates on end results

Table 4 is an attempt to show the effect on the eventual result of varying choledochostomy rates. The series from the unit of the senior author (J.S.) was extracted from the total. This series had a choledochostomy rate of 35 per cent.; the remainder had a choledochostomy rate of 19 per cent. It will be observed that it has not been statistically established that opening more bile ducts cures more patients.

The danger of cancer and of symptoms in symptomless gall-stones

An attempt was made to analyse the danger of cancer developing in a gall-bladder which contains stones. The records of this hospital show that there have been 10 admissions for cancer of the gall-bladder in the years 1950 to 1955 inclusive. This works out at 1.66 per year. This hospital contains about two-thirds of the beds of this area, which has a population of about 200,000 people. At the Royal Melbourne Hospital, in 3,685 consecutive post-mortems, 17 per cent. of those examined over the age of 45 had gall-stones in their body (Joske, Saint, Bromilow and Hughes, 1954). The Australian Life Tables show that about one-third of the population is aged over 45; hence the number over 45 with gall-stones in Newcastle is about $\frac{1}{3} \times 200,000 \times \frac{17}{100} = 11,020$. The number of potential Royal Newcastle Hospital patients from this group is $\frac{2}{3} \times 11,020 = 6,612$. The expectation of life at the age of 45 is about 30 years and at 60 is about 15 years. It has been alleged that cancer is more commonly found in gall-bladders which contain stones. Accepting this as a fact, the chance of cancer of the gall-bladder if gall-stones are present is $\frac{30 \times 1.66}{6,612}$, which is $\frac{1}{132}$ at the age of 45, and $\frac{1}{264}$ at the age of 60. If the patient is nearing 70, the chance of cancer occurring in the gall-bladder, if there are stones also present, must be approximately one in five hundred. This means that if his elective mortality rate for operation is under 0.4 per cent. a surgeon can cheerfully advise a 60-year-old man to have his symptomless gall-stones out before a cancer occurs, as it would appear to be bad counsel to advise a patient to run the risk of death from operation when that risk exceeds the likelihood of cancer developing.

Whilst engaged on this survey, it was considered that it would be interesting to try to form an assessment as to what was the chance of needing an operation if a patient had gall-stones. As approximately 100 operations on the biliary tract are done at the Royal Newcastle Hospital per year, it was thought that at the age of 45 the chance of needing an operation was $\frac{30 \times 100}{6,612}$, which is approximately 1 in 2, and that the chance of needing an operation if gall-stones are present at 60, as the expectation of life is only half that at 45,

is approximately 1 in 4. This question as to the necessity for operation is of interest in, for example, the following case. A hysterectomy is being performed on a patient of 40 years and the surgeon notices that the patient has gall-stones which have never caused symptoms. What should she be advised? From the figures produced, it seems reasonable to tell her that if she is 40 there is only an even chance that the gall-stones will ever worry her, and that if she is 60 there are three chances out of four that they will never cause her any symptoms.

The error of cholecystectomy for peptic ulcer

In reviewing the patients on whom a cholecystectomy was performed, and a peptic ulcer found, it was noted that the operation was performed on the basis of a positive Graham's test. In view of this finding, it seemed appropriate to review the reliability of this test. This test was introduced in 1924. The literature of the 1926 era abounds with articles pointing out the fallacies of the test.

Those mentioned are:

1. Peptic ulcer.
2. Exophthalmic goitre.
3. Pregnancy.
4. Diabetes.
5. Forgetting to take the tablets.
6. Vomiting the tablets.
7. Iodine sensitivity.
8. Diarrhoea after taking the tablets.

Several Continental authors have gone to some trouble to discover how unreliable Graham's test is in the presence of peptic ulcer; e.g. Orator (1927) discovered that in 25 cases of peptic ulcer the gall-bladder shadow failed to show in 15 patients; Bruno Thom (1931) showed that in 46 cases of peptic ulcer, the gall-bladder failed to show in six. In this hospital Dr. R. Gibson and one of us (J.S.) have re-investigated several patients whose gall-bladder failed to show in a Graham's test, but whose history suggested peptic ulcer. After ulcer treatment, the Graham's test was successful in showing the gall-bladder. In view of the above, it is easy to understand why it has been advised that reliance be not placed on a "positive" result unless the examination has been repeated with similar result. Even then the "positive"

result may not arise from a diseased gall-bladder. Hence the surgeon has only himself to blame if he discovers that the gall-bladder is normal but that a duodenal ulcer is present when laparotomy is performed because of a positive Graham's test. This mistake is due, it may be said, to failure of the radiologist to find the ulcer, or to show the gall-bladder when it is normal; but it is more correct for the surgeon to assume that he has failed to take the patient's history correctly. It is worth noting, of course, that the radiologist usually reports that the gall-bladder is "pathological according to Graham's test"; not that it is "pathological," that it is "pathological according to the test." It is suggested that by far the best modern use for Graham's test is to decide whether the pain of which the patient complains is really biliary colic or not. A Graham's test does not assure that this is so, even if it is abnormal, but it is at least a useful pointer.

Post-cholecystectomy syndrome

The findings of this survey make the concept of a post-cholecystectomy syndrome difficult and confusing. Ideas on post-cholecystectomy syndromes are determined by what surgeons expect of the operation. For example, the gall-bladder may be removed because the patient has biliary colic plus dyspepsia, and the dyspepsia persists after the operation. This could be described as a post-cholecystectomy syndrome. But as this survey shows that two-thirds of these patients would still have dyspepsia, such a description seems to have little meaning. Perusal of the literature on post-cholecystectomy syndrome has done little to ease the confusion.

CONCLUSIONS

If a return is made to the original American statements of this paper, it will be remembered that they were "that calculous cholecystitis whether symptomless or not is an indication for remedial surgery." In the face of this survey, this is at least doubtful. Secondly, it was said "that gall-bladder disease should be eradicated before patients reach old age and develop complications such as jaundice, acute inflammation or malignancy." Seeing that the older the patient gets the less chance there is of complications, until at advanced age there is a statistically quite small chance, this also appears to be somewhat doubtful. Thirdly,

"we doubt whether there is such a thing as a 'silent' gall-stone," but apparently if the matter is reduced to figures there is no doubt that there is such a thing as a 'silent' gall-stone. Recent work confirms this (Horn, 1956). Fourthly, "they should be removed before they shriek with malignancy." The language is extravagant and this survey suggests that the ideas behind it are also extravagant.

It would appear from this follow-up that there are certain trustworthy indications for biliary surgery, certain less trustworthy ones and some common mistakes. It would seem that the trustworthy indications are:

1. Biliary colic.
2. Obstructive jaundice.
3. Acute cholecystitis.

That the less trustworthy ones are:

1. Dyspepsia, because two in three recur.
2. A "positive" Graham's test, of itself.
3. Incidental stones (e.g. found at laparotomy).
4. The fear of cancer.

And that the common errors are:

1. Peptic ulcer, and
2. Operating for pains which are not biliary colic, e.g. due to spondylitis.

There is nothing new in these findings. Before there were radiological investigations of the biliary tract; before there were X-rays of the gall-bladder, patients had their gall-bladders removed because they had biliary colic, obstructive jaundice or acute cholecystitis. It is and always has been true that the patient's history is of the first importance.

SUMMARY

1. The mortality rate for all biliary tract surgery for stone should be in the vicinity of 1 per cent., with a lower figure for elective surgery.
2. Registrar training does not raise operative mortality. It aids in lowering it.
3. The addition of choledochostomy to cholecystectomy does not elevate the mortality rate.

4. Choledochostomy is required so frequently in biliary tract surgery that there is no place for the cholecystectomist who rarely, if ever, performs it.
5. The removal of all stones in the bile ducts (Lahey's "third stage") has not yet been achieved.
6. The relating of operation and admission figures to give an operation rate per thousand admissions is worth investigation.
7. A follow-up of 951 patients showed that there were certain reliable indications for biliary tract surgery, certain less reliable ones, and some common errors.
8. During the follow-up the opportunity was taken to study biliary colic, jaundice and fatty dyspepsia.
9. An attempt was made to estimate the likelihood of the development of cancer or of symptoms in those with symptomless gall-stones.
10. It would appear from this study that undue reliance on Graham's test can result in a cholecystectomy being performed when the only lesion present is a peptic ulcer.
11. In view of the vague descriptions of the post-cholecystectomy syndrome in the literature, this review suggests that the post-cholecystectomy syndrome is made up of these symptoms which the surgeon thought the operation should have removed. The subject is confused.
12. This study confirms the very old idea that the patient's history is important.

ACKNOWLEDGEMENTS

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REFERENCES

- CRUMP, C. (1931), *Surg. Gynec. Obstet.*, vol. 53, page 447.
- GRAHAM, E. A. (1927), *Surg. Gynec. Obstet.*, vol. 44, page 153.
- GRAHAM, E. S. and COLE, W. H. (1924), *J. Amer. med. Ass.*, vol. 82, page 613.
- HORN, G. (1956), *Brit. Med. J.*, vol. 2, page 732.
- HOROWITZ, A. (1956), *J. Amer. med. Ass.*, vol. 161, page 1119.
- JONES, F. A. Personal communication.
- JOSKE, R. A., SAINT, E. G., BROMILOW, F. J. and HUGHES, E. S. R. (1954), *Med. J. Aust.*, vol. 2, page 473.
- LAHEY, F. H. (1938), *Amer. J. Surg.*, vol. 41, page 209.
- MENTZER, S. H. (1926), *Surg. Gynec. Obstet.*, vol. 42, page 782.
- ORATOR, V. (1927), *Dtsch. Z. Chir.*, vol. 205, page 82.
- THOM, C. (1931), *Röntgenpraxis*, vol. 3, page 17.
- TURNER, G. Grey, Ed. (1943), "Modern Operative Surgery." London, Cassell. 3rd Edition, page 828.
- WILDEGANS, H. (1956), *Chirurg*, vol. 27, page 1.

HEPATO-PULMONARY HYDATID DISEASE

By IAN McCONCHIE

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AN enlarging hydatid cyst near the sub-diaphragmatic surface of the liver is more liable to involve the lung and pleural cavity than the peritoneal cavity and the bile ducts. Enlargement of the liver cyst is due to growth of a unilocular cyst, development of daughter cysts, infection, or any combination of these processes.

The intact enlarging liver cyst may extend into or invade the lung or pleural cavity; or it may rupture and discharge hydatid membrane, daughter cysts, bile, pus and blood into a bronchus, a lung abscess, or the pleural cavity.

Five intrathoracic complications of liver hydatid disease are recognised (Figs. I-IV).

1. *Extension of the intact liver cyst into the subphrenic space, thence through the diaphragm into the pleural cavity.*

Case 1

J.L., a male farmer, aged 18 years, complained on 4th July, 1954, of lower right pleuritic pain and a dull ache in the right loin on bending. These symptoms had been present for a week. No abnormality was found on physical examination.

An X-ray of the chest and right liver region showed two oval opacities, with calcified margins, in the lower right chest, and a spherical opacity with a calcified edge just below the right hemidiaphragm (Figs. VIa) and (b)).

The Casoni test was positive.

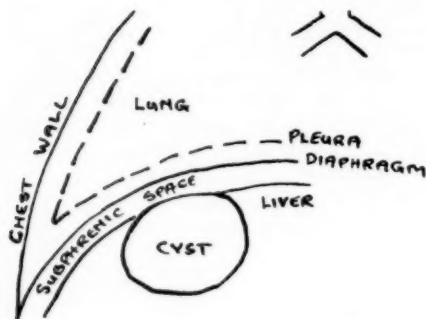


FIG. I. Hydatid cyst in upper pole of liver.

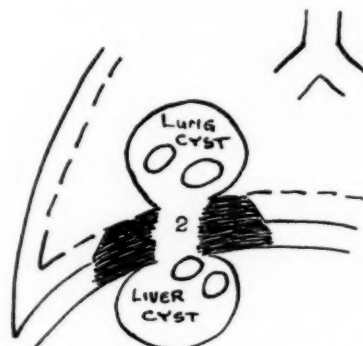


FIG. III. Hepato-pulmonary hydatid disease.

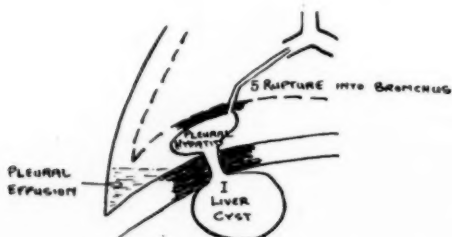


FIG. II. Hepato-pleural hydatid disease, without and with a broncho-pleural fistula.

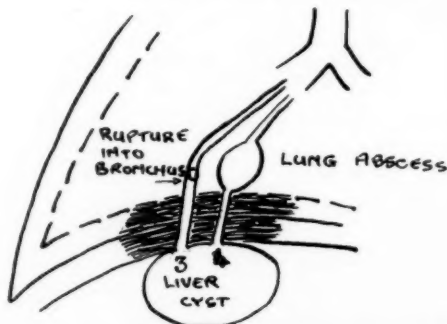


FIG. IV. Hepato-bronchial fistula, without and with an intervening lung abscess.

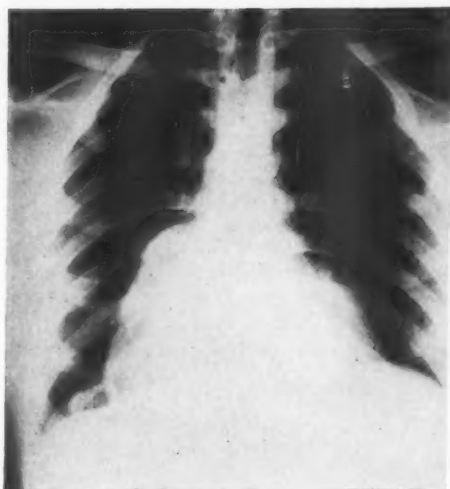


FIG. V(a)



FIG. V(b)

On 13th August a lower right thoracotomy was done. A bilocular cystic mass was found in the pleural cavity. One loculus was situated in the paravertebral groove, and the other loculus was immediately above the diaphragm in the cardiophrenic angle. The two loculi communicated by a narrow waist. The walls of the loculi contained plaques of calcium. The bilocular cyst was easily dissected off the chest wall, lung and diaphragm. It was then found that a track, half an inch in diameter, passed from the communicating waist through the diaphragm. The diaphragm was opened in front of, and behind, this track. The track joined a cystic mass in the subphrenic space which communicated with a cyst, two inches in diameter, in the upper pole of the liver. The subphrenic and liver cysts were enucleated. The intact cyst removed from the pleura, subphrenic space and liver was trefoil in shape, calcified in parts, and contained grey, inspissated, sterile pus and hydatid membrane (Fig. VI). The adventitial wall of the liver cyst was heavily calcified. This was excised with surprisingly little haemorrhage, and the edges of liver fell together. The liver surfaces were sutured together with chromic catgut. The diaphragm was closed, and the pleural cavity was drained.

Convalescence was uncomplicated.

Comment

The hepato-pleural cyst was detected and excised intact before it ruptured and discharged its contents into the pleural cavity or lung. Consequently neither empyema nor expectoration of bile occurred pre-operatively.

An important part of the treatment was excision of the calcified adventitia from the liver. Unless this is done the calcified liver

cavity will continue to discharge bile and pus for a very long time — this, of course, will necessitate the wearing of a drain tube for as long as the discharge persists.

It was interesting, instructive and helpful in the management of subsequent cases, to see how readily the liver surfaces fell together and obliterated the cavity after excision of the adventitia.

2. Extension of the liver hydatid through the diaphragm, into the lung, causing lung hydatid disease.

The lung component of the hydatid then ruptures into a bronchus and the patient expectorates hydatid membrane and daughter cysts, and develops infection within the lung hydatid and pneumonitis around the lung cyst.

Case 2

G.C., a male, aged 45 years, had three operations for liver hydatids as a child.

In September, 1947, he developed a right lower lobar pneumonia, and he subsequently coughed up hydatid membrane.

The Casoni test was positive.

A chest X-ray showed an abscess cavity with a fluid level in the right lower lobe. No calcification was seen in the liver.

On 29th October, 1947, a right thoracotomy was done and pus, hydatid membrane and innumerable daughter cysts were removed from a large adventitial

cavity in the right lower lobe. The lung cavity was emptied of all hydatid elements. No track, passing from the lung cavity, through the diaphragm into the liver, was found. The adventitial cavity in the lung was drained.

The patient's fever persisted, and he continued to discharge daughter cysts through the drain tube and bronchial tree. It was realised that the lung cavity must communicate with a liver hydatid containing daughter cysts.

The lung cavity was therefore re-opened and the track, passing from lung, through diaphragm into liver, was again sought and this time it was found.

If the wall of the cavity in the liver is calcified it should be excised, otherwise dependent drainage of the liver cavity, after removal of the hydatids, is adequate.

Case 3

E.W., a male, aged 39 years, was admitted to hospital on 23rd July, 1953. Ten weeks prior to admission he had coughed up blood, hydatid membrane, and daughter cysts. Hydatids were palpable in the liver and elsewhere in the abdomen, and cysts were obvious in the lower half of the right lung.



FIG. VI

A large hydatid in the upper aspect of the liver was evacuated of hydatid membrane and daughter cysts. The adventitial lining of the liver hydatid was not calcified. The liver cavity was provided with dependent drainage through a separate transcostal incision, the drain tube track traversing the obliterated phrenico-costal sinus, diaphragm and a thin shell of fibrosed liver.

Both lung and liver cavities took three months to close.

On 26th February, 1952, a hydatid cyst was removed from the upper lobe of his right lung.

The patient has been well since.

Comment

Daughter cysts in a lung hydatid usually mean a communication between the lung hydatid and a liver hydatid.

In such cases a hepato-pulmonary fistula must be sought at operation and the liver hydatids removed.

On 25th July a right thoracotomy was done and innumerable cysts were removed from the right lung and liver.

He continued to drain and cough up daughter cysts for the next fourteen months.

In 13th September, 1954, another right thoracotomy was done and more cysts were removed from the right lower lobe and the subphrenic space.

On 3rd May, 1957, a chest X-ray showed increased elevation of the right diaphragm.

Another thoracotomy was done and numerous daughter cysts and a large amount of hydatid membrane were again removed from the liver.

At present a chest X-ray suggests another cyst in the middle lobe of his right lung.

Comment

There may be several unilocular cysts, and a cyst containing daughter cysts in the liver. These liver cysts may communicate or be separated from each other by thin septa of

liver. At the first exploration of the liver some of these cysts may not be found. Subsequently those cysts left behind may raise the diaphragm, discharge through the original wound, or invade the lung.

It is suggested that an extensive hepato-pulmonary hydatid disease process be approached through a long thoraco-abdominal

incision, rather than through a limited thoracotomy incision. By the use of this extended incision liver cysts, adjacent to the one detected because of its extension into the lung, are unlikely to be overlooked. Furthermore, dependent drainage of the liver cavity can be more surely provided through a thoraco-abdominal than through a thoracotomy incision.

3. *A direct fistulous track develops between the liver hydatid and a branch of the lower lobe bronchus.*

The liver hydatid becomes infected and ruptures, and a subphrenic abscess forms. The visceral and diaphragmatic pleura above the abscess become adherent, and the pleural space in this region becomes obliterated. The subphrenic abscess ruptures, through the diaphragm and fused pleural layers, into lower lobe of the lung. The contents of the abscess usually rupture straight into a branch of the lower lobe bronchus. The patient coughs up bile, pus, blood, and possibly hydatid membrane. A little pneumonitis develops around the fistulous track in the lung; but the passage of bile through the lung and up the bronchi causes surprisingly little pneumonitis or bronchitis.

An X-ray will show a little lower lobe pneumonitis, and it may show a fluid level below the diaphragm, or the shadow of a calcified cyst in the liver. The expectoration of bile, even in the absence of the described X-ray findings of liver hydatid disease, is probably due to hepato-pulmonary hydatid disease; but it may be due to hepato-pulmonary trauma, obstructive lesions in the biliary passages, and liver abscess.

Case 4

J.C., a male, aged 48 years, was admitted to hospital on 13th April, 1955. During the preceding fifteen months he had suffered from recurring attacks of right-sided pleuritic pain, and he had lost weight

steadily. A chest X-ray taken three weeks prior to his admission to hospital showed a small right basal pleural effusion (Fig. VII). For one week prior to his admission to hospital he had suffered from fever, dyspnoea, and repeated haemoptyses. When examined on admission, his temperature was 101.4°F, he had the signs of a large right pleural effusion with displacement of the mediastinal structures to the left and he was coughing up blood-stained pus.



FIG. VII

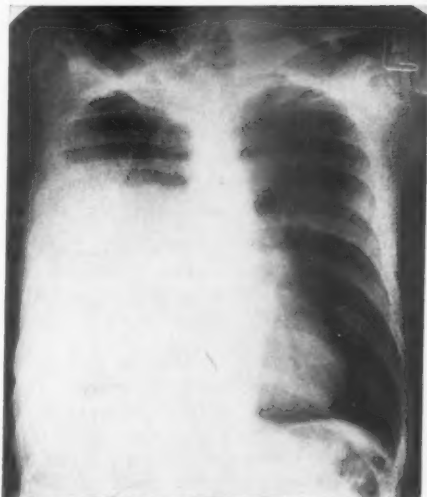


FIG. VIII

An X-ray showed a large right-sided pleural effusion (Fig. VIII) and a diagnostic chest aspiration withdrew pus from the right pleural cavity. On 15th April bronchoscopy showed no evidence of carcinoma, and his empyema was adequately drained through the bed of the resected 10th rib.

Although the empyema was adequately drained and there was no clinical or X-ray evidence of pneumonia and he received chemotherapy appropriate for the organisms in his empyema pus and sputum, his fever and haemoptyses persisted. The long history of pleurisy and weight loss and the absence of any evidence of lung disease in an X-ray taken three weeks prior to admission, suggested that he was suffering from chronic infective liver disease. He was therefore given a course of emetine; but this did not cause his fever to abate. On 14th May he started to cough up bile and, on 16th May, an X-ray of the liver area showed a calcified hydatid, two inches in diameter, in the upper pole of the liver.

On 21st May a right thoraco-abdominal incision exposed a calcified hydatid in the subdiaphragmatic region of the right lobe of the liver. This communicated with a small subphrenic abscess which, in turn, communicated with the lung via a narrow fistulous track through the diaphragm. The hydatid was removed from the liver and the calcified adventitial wall of the liver cavity was completely excised. Haemostasis was fairly satisfactory but was not complete. A drain tube was placed in the subphrenic space, and the liver cavity was packed with gauze. The fistulous track between the subphrenic abscess and the lung was not touched.

Fever and the expectoration of bile ceased immediately. After five days the gauze packing in the liver cavity was replaced by a drain tube. All drain tubes in the empyema, subphrenic abscess and liver cavity were out and the wounds healed, when he was discharged from hospital on 19th June, 1955. He has remained well since then.

Comment

Chronic liver disease preceding the development of his empyema was suggested by the patient's long standing symptoms. However, emergency drainage of his empyema, a complication of his liver hydatid, was necessary.

The true nature of his liver disease was eventually revealed by a failure to respond to emetine, the expectoration of bile, and the demonstration by X-ray of a calcified hydatid cyst in the upper portion of the right lobe of the liver.

Removal of the infected liver hydatid, and dependent drainage of the subphrenic abscess, was correct and adequate treatment. It was not necessary to excise the fistulous track through the lung—expectoration of bile stopped as soon as the subdiaphragmatic infective focus was dealt with adequately.

Again, the importance of excision of the calcified adventitial wall of the liver cavity is stressed. The liver cavity ceased to drain and the drain tube was removed in less than one month.

Case 5

A.T., a female, aged 60 years, was admitted to hospital on 3rd July, 1947. In 1943 a liver hydatid was removed, and the calcified adventitial cavity was drained. After removal of the drain tube a sinus developed in the right hypochondrium which continued to drain bile and pus intermittently. When drainage ceased the patient became ill and febrile. She also developed cirrhosis of the liver and splenomegaly and she had repeated haematemesis. A sinogram outlined a cavity in the subdiaphragmatic part of the right lobe of the liver.

An attempt to establish better drainage of the liver cavity by an abdominal approach was abandoned because of excessive bleeding from the liver. The incised sinus track and liver were packed and bleeding ceased.

Soon after this she started to cough up a lot of bile. It was decided to evacuate and drain the liver cavity by the more direct transthoracic-transdiaphragmatic route. A segment of rib was removed and the liver cavity entered across the obliterated costophrenic sinus, diaphragm and obliterated subphrenic space. The cavity wall was calcified and the cavity contained some residual hydatid membrane. The cavity was evacuated; but the calcified adventitial wall could not be removed because excessive bleeding demanded the rapid packing of the cavity with gauze. The cavity was packed with gauze on three occasions before the bleeding ceased. It was then possible to insert a drain tube into the liver cavity.

It took six months before the liver cavity became obliterated and the drain tube was removed. The patient has remained well since then.

Comment

The subdiaphragmatic hydatid, originally operated on by an abdominal approach in 1943, was not completely evacuated of hydatid membrane. For this reason, and because the calcified adventitia was not removed at the original operation, the original drainage sinus did not close permanently between 1943 and 1947.

It is suggested that upper pole liver hydatids are best approached, and more surely completely removed, by a transthoracic approach.

The advisability of excising the calcified adventitia from the liver is reiterated—a cavity with a calcified wall will drain for a very long time.

As in Case 4, expectoration of bile ceased as soon as dependent drainage of the liver cavity was established.

It was not necessary to excise the hepato-bronchial fistula.

4. A liver cyst communicates with a lower lobe lung abscess which ruptures into a bronchus.

An infected liver hydatid ruptures, and discharges its contents through the subphrenic space, diaphragm, and fused pleural layers into the substance of the lower lobe of the lung, where a lung abscess forms. This abscess ruptures into a bronchus and the patient coughs up bile, pus, blood and hydatid elements.

Case 6

A.A., a female, aged 60 years, was admitted to hospital on 8th February, 1956. She complained of right-sided pleuritic pain for the previous nine weeks. For the previous five weeks she had been feverish and had been coughing up a cupful of blood-stained bile and pus each day.

Her chest X-ray showed an abscess cavity with a fluid level in the right lower lobe. The Casoni test was positive. At bronchoscopy hydatid membrane was extracted from the orifice of the bronchus to the apical segment of the right lower lobe. The liver cyst responsible for the expectoration of bile was not demonstrable radiologically.

A thoraco-abdominal incision was made. The pleural space was obliterated. Pus was obtained on aspirating the subphrenic space through the exposed diaphragm. The diaphragm was incised and a subphrenic abscess was evacuated. This abscess communicated with a unilocular, infected hydatid with a non-calcified adventitial wall in the upper aspect of the liver. The hydatid and its adventitial wall were enucleated from the liver and the liver cavity was easily obliterated by sutures. The perforation in the diaphragm, through which the subphrenic and liver abscesses communicated with the lung abscess, was found and the lung abscess was sucked out. The subphrenic space was drained.

The lung abscess healed rapidly, and by the 29th March the subphrenic abscess was healed and the drain tube was removed. The patient has remained well since operation.

Comment

Excision of the liver hydatid, and dependent drainage of the subphrenic abscess, supported by chemotherapy, resulted in healing of the lung abscess. It was not necessary to drain or resect the lung abscess.

5. The infected liver hydatid ruptures through the diaphragm and discharges its contents into the unobliterated pleural cavity. An empyema, with hydatid infestation of the pleural cavity results. The empyema then ruptures into a bronchus, and again the patient coughs up pus, bile and hydatid elements.

Case 7

M.T.W., a female, aged 43 years, entered hospital on 22nd May, 1957. She complained of right-sided pleuritic pain for two weeks prior to admission. She had been coughing up blood-stained pus for four days prior to admission.

On examination she had a temperature of 101°F and signs and X-ray evidence of a right pleural effusion. Hydatid elements and bile were present in the pus aspirated from the right pleural cavity. The Casoni test was positive.

On 30th May she commenced coughing up bile-stained sputum.

On 31st May a right thoracotomy was done and a large empyema was found. The contents of the empyema cavity were removed, and the lung and chest wall were decorticated. A large amount of hydatid membrane was present in the anterior part of the pleural cavity. This membrane passed through a small perforation in the diaphragm into a liver cavity. The membrane was removed, and the liver cavity was inspected after slight enlargement of the perforation in the diaphragm. The walls of the liver cavity were not calcified. No hydatids were found adjacent to this liver cavity. A broncho-pleural fistula, involving the anterior basal segment of the lower lobe was obvious. The pleural cavity and the liver cavity were drained.

Expectoration of bile ceased immediately.

At the time of writing this patient has an open drain tube in a small residual empyema.

Comment

This complication of liver hydatid disease is unusual, because the base of the pleural cavity is usually obliterated by adhesions between the lung and the diaphragm when a patient has an infected hydatid in the sub-diaphragmatic region of the liver.

Decortication of the lung and chest wall is advised when hydatid infestation of the pleural cavity is found at operation. It is the best procedure for the prevention of recurrence of pleural hydatid disease.

SUMMARY

The surgical anatomy of five types of intrathoracic complication of liver hydatid disease has been described.

Seven case histories, illustrating the clinical picture and the surgical treatment of each type of hepato-thoracic hydatid disease, are presented. Mr. John Hayward operated on Cases 2, 3 and 5, and I thank him for permission to include their clinical histories in this series.

If the subdiaphragmatic hydatid disease is adequately treated complicating lung abscesses and broncho-biliary fistulae will heal. Definitive closure of a broncho-biliary fistula is not indicated and drainage of a lung abscess or pulmonary resection will not be necessary.

If pleural complications are present, both these and the liver hydatid require surgical treatment. The empyema contents must be evacuated, the lung and chest wall decorticated and the pleural cavity drained.

A large hepato-pulmonary hydatid cyst is best approached through a long thoraco-abdominal incision. This exposure makes it more likely that all hydatid cysts will be removed, under vision, from the liver.

After removal of the hydatid from the liver, the adventitia, if calcified, should be excised. Haemorrhage is usually severe; but

it can usually be controlled. Excision of the calcified adventitia decreases greatly the period of drainage from the liver cavity—an infected, calcified liver cavity may drain forever. I am grateful to Mr. Fitzpatrick of Hamilton for suggesting an alternative method of dealing with a liver cavity with a calcified adventitial wall. He suggests that the wall be swabbed and scraped, and the cavity closed by suture, and he advises against drainage of such cavities, even when obviously infected. In his extensive experience infection seldom recurs, and it is therefore rarely necessary to re-operate to drain a liver cavity so treated. This method of treatment certainly eliminates the possibility of a fatal haemorrhage from the liver during excision of the calcified adventitia.

The coughing up of daughter cysts and the finding of daughter cysts in a lung hydatid at operation, usually mean that the patient is suffering from hepato-thoracic hydatid disease. The liver hydatid should be sought and treated. It is realised that primary lung hydatids occasionally contain daughter cysts and that daughter cysts in a lung or pleural hydatid, which has developed because of spillage of hydatid elements due to a previous operation for lung hydatid, is fairly common.

In Australia the commonest cause of the coughing up of bile is hepato-pulmonary hydatid disease.

EXPERIMENTAL PANCREATIC NECROSIS

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THE main purpose of this communication is to record the results of an experiment in which necrosis of the pancreas was induced in five dogs. The possibility of a relationship between this experimental necrosis and the necrosis which occurs in man, both spontaneously and post-operatively, is discussed.



FIG. I. The normal pancreas of dog number four, before bile injection.

This investigation was initiated following certain observations on pancreatic necrosis in man. The opportunity to examine the human pancreas affected by this disease occurs less frequently now that non-operative treatment is the rule. However, from time to time one operates upon a case of spontaneous pancreatic necrosis, mistaking it usually for one of perforated peptic ulcer. On these occasions the author has been impressed by the frequency with which the diseased pancreas and the retroperitoneal tissues around it have been stained with bile. This has been so particularly in the first few hours of the disease. This feature of the spontaneous type of pancreatic necrosis has been noted and recorded by other observers. In 1956 the author also had the opportunity to observe a case of post-operative pancreatic necrosis. This was in a somewhat obese man of fifty-five years who had an operation for the removal of a paravaterian duodenal diver-

ticulum. Two days after operation he became very ill, with severe abdominal pain, and his abdomen was re-opened. Acute pancreatic necrosis was present, with widespread fat necrosis. There was a good deal of intra- and retroperitoneal bile, which appeared to be coming from the region of the operation on the duodenum. The pancreatic region was drained, without benefit. The man died four days later.



FIG. II. The swollen and haemorrhagic pancreas of dog number four, seven days after bile injection.

The frequent association of retroperitoneal bile staining and pancreatic necrosis suggests that the former phenomenon is either a cause or an effect of the necrosis. An experiment was designed to test the possibility of it being a cause.



FIG. III. An area of fat necrosis near the diffusely swollen and indurated pancreas of dog number five, three days after bile injection.

TABLE 1

Dog	Weight	Volume of Bile Injected	Duration of Expt.	Post-mortem Findings	
				Macroscopic	Microscopic
1	12½ lbs.	4.0 ccs.	2 days	Several ounces of sero-sanguinous fluid in peritoneal cavity. Areas of fat necrosis scattered widely in extra-peritoneal tissues. Diffuse swelling, induration and haemorrhage in pancreas.	Glandular necrosis. Fat necrosis. Haemorrhage and thrombosis. Moderate amount of leucocyte infiltration.
2	29 lbs.	8.0 ccs.	4 days	No fluid in the peritoneal cavity. Areas of fat necrosis in vicinity of pancreas. Pancreas diffusely swollen and indurated. Half of pancreas haemorrhagic.	Glandular necrosis. Fat necrosis. Haemorrhage and thrombosis. Very little leucocyte infiltration.
3	19 lbs.	4.0 ccs.	2 days	Six ounces of sero-sanguinous fluid in the peritoneal cavity. Numerous areas of fat necrosis in vicinity of pancreas. Pancreas diffusely swollen, indurated and haemorrhagic.	Glandular necrosis. Fat necrosis. Haemorrhage and thrombosis. Considerable leucocyte infiltration in some areas.
4	18 lbs.	10.0 ccs.	7 days	Several ounces of sero-sanguinous fluid in the peritoneal cavity. No fat necrosis. Pancreas diffusely swollen, indurated and haemorrhagic.	Extensive glandular necrosis. Glandular tissue remaining surrounded by young fibrous tissue. Fat necrosis. Haemorrhage and thrombosis. Minimal leucocyte infiltration.
5	33 lbs.	6.0 ccs.	3 days	No free fluid in the peritoneal cavity. A few areas of fat necrosis around the pancreas. Pancreas diffusely swollen, indurated and haemorrhagic.	Glandular necrosis. Fat necrosis. Haemorrhage and thrombosis. Minimal leucocyte infiltration.

The experiment

Five adult mongrel dogs were used. In each case, using an aseptic technique and after anaesthesia had been induced by the intravenous injection of sodium pentobarbitone, laparotomy was performed. With a needle and syringe the gall-bladder bile was aspirated. The resulting puncture in the gall-bladder fundus was closed with a purse-string suture and the gastro-colic omentum was divided to expose the pancreas. The needle and syringe used for aspiration were then used to inject the bile beside the pancreas. In each case the needle was inserted through the posterior wall of the lesser sac, just above the junction of the two limbs of the pancreas,

near the duodenum. Bile was injected very gently, so as to exclude any mechanical disrupting effect. The bile was observed to diffuse in the tissues around the pancreas and the abdomen was then closed. After an interval, varying from two to seven days, each animal was killed by the intravenous administration of sodium pentobarbitone and a post-mortem examination was held. The pancreas was examined histologically in each case and in the last four cases each stage of the experiment was photographed. The procedure and findings in each dog are summarized in Table 1. Figures I to VII are photographs illustrating various features of the experiment in the last four dogs.

DISCUSSION

This work has shown that, in the dog, a relatively small amount of bile in the retroperitoneal tissues around the pancreas causes acute haemorrhagic necrosis of that organ. The human pancreas may respond in a similar way to contact with bile and this may account for some cases of pancreatic necrosis in man.



FIG. IV. Several areas of fat necrosis scattered around the diseased pancreas in dog number three, two days after bile injection.

There are certain features of spontaneous pancreatic necrosis which suggest that retroperitoneal biliary extravasation may sometimes be its cause. It is known that such extravasation can and does occur in this disease. This bile must escape directly or indirectly from the bile duct system. A direct escape from the bile ducts seems the more likely because it is simpler than the alternatives of bile escape via the duodenum or the pancreatic duct system. A small perforation of the common bile duct, especially near its lower end, would serve the purpose well. It is known that spontaneous intraperitoneal perforation of the bile duct system does sometimes occur, giving rise to biliary peritonitis. Spontaneous retroperitoneal perforation may also occur and give rise to pancreatic necrosis.

In this connection it is of interest to note the frequency with which spontaneous pancreatic necrosis has a dramatically sudden onset, accompanied by other symptoms and signs which suggest perforation of a hollow viscus. Perforation of the common bile duct has actually been observed in spontaneous pancreatic necrosis. Zaslow (1953) reports two cases of "acute pancreatitis," with "necrosis and perforation of the lower portion of the common bile duct." In these two cases the hole in the duct was large and biliary extravasation was extensive. Zaslow attributed the duct necrosis to the "pancreatitis." He may have been wrong in this assumption. The duct perforation and subsequent bile leakage may have caused the pancreatic necrosis in each of these cases. In other cases smaller and less easily detectable perforations of the common duct may occur, to cause the disease.

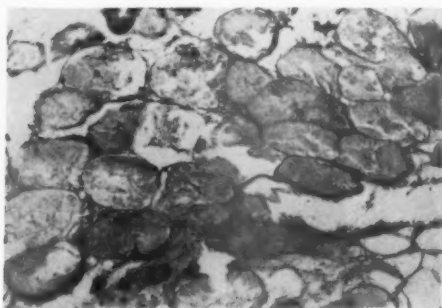


FIG. V. Fat necrosis, in dog number five. (x120)

Pancreatic necrosis occasionally occurs in man as a post-operative complication. In studying this form of the disease one is impressed by the fact that the preceding operation is usually on or near the common bile duct. Exploration of the common bile duct, division of the sphincter of Oddi, excision of a duodenal diverticulum and gastrectomy are all operations which have been reported as antecedents of pancreatic necrosis. Accidental perforation of the wall of the common bile duct, allowing a leak of bile into the peri-pancreatic tissues is a possibility in all of these operations.

Many hypotheses have been put forward to account for pancreatic necrosis. None of them are completely acceptable and because

of this, further proposals, such as the one made here, will no doubt continue to appear. Of the current hypotheses, those of bile diversion into the pancreatic duct system, made by

Opie (1901) and Archibald (1919) and of pancreatic duct obstruction, made by Rich and Duff (1936), are the most popular. The objections to each of these explanations are widely known and are such as to render them at least questionable.

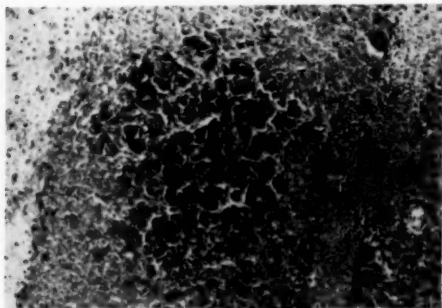


FIG. VI. Pancreatic glandular necrosis and interstitial haemorrhage, in dog number two. (x 120)

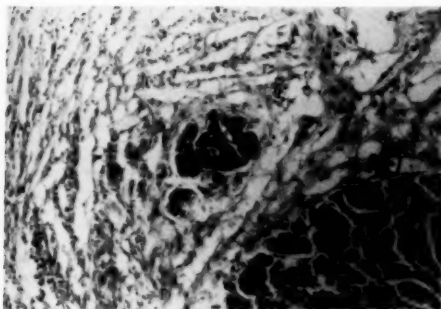


FIG. VII. Early interstitial fibrosis isolating a surviving gland nodule, in dog number four. (x 120)

SUMMARY

A method of inducing pancreatic necrosis in dogs is described. The possible significance of this in regard to pancreatic necrosis in man is discussed.

ACKNOWLEDGEMENTS

I would like to express my gratitude to Dr. D. F. Stewart, Director of the McMaster Laboratory of the Commonwealth Scientific and Industrial Research Organization. This work was made possible by his generosity in placing the resources of the Laboratory at my disposal. I am also indebted to Mr. F. Hamilton, Senior Technical Officer at the Laboratory, for his enthusiastic and skilful assistance. I am grateful to Dr. J. M. Garvan, Director of the Department of Pathology, St. Vincent's Hospital, for his work and opinion on the micropathology.

REFERENCES

- ARCHIBALD, E. (1919), *Surg. Gynec. Obstet.*, vol. 28, page 529.
- OPIE, E. L. (1901), *Bull. Johns Hopk. Hosp.*, vol. 12, page 182.
- RICH, A. R. and DUFF, G. L. (1936), *Bull. Johns Hopk. Hosp.*, vol. 58, page 212.
- ZASLOW, J. (1953), *Arch. Surg. (Chicago)*, vol. 67, page 47.

INTESTINAL DUPLICATION

By D. I. ROBERTS

Launceston, Tasmania

DUPLICATION can occur along the whole length of the alimentary canal, the various terms such as gastro-thoracic cyst, inclusion cyst, giant diverticulum, ileum duplex and enterogenous cyst being simply different names for the same basic developmental anomaly occurring in different situations. The most common form is intestinal duplication, and the purpose of this paper is to record a case with several unusual features, which presented as an acute abdominal emergency. The general features of intestinal duplication are also discussed.

Abdomen rigid all over, with absent bowel sounds and diminution of liver dullness. He was tender on rectal examination.

Straight X-ray of the abdomen showed no evidence of perforation or obstruction, but a fluid level suggesting a local ileus was present in mid-abdomen.

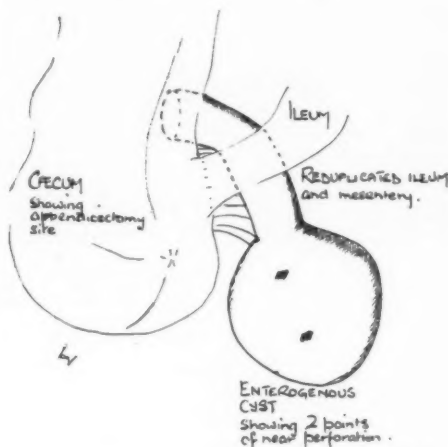


FIG. I. The findings at operation.



FIG. II. The specimen before section.

Case history

A man of 60 was admitted to hospital on the 22nd January, 1957, with a three-hour history of upper abdominal pain of sudden onset, which was gradually increasing in severity. He had vomited soon after the pain commenced. Until his illness, his appetite had been good and his bowels and micturition regular. There was no recent history of dyspepsia. He had had a perforated gastric ulcer sutured in 1942 and a partial gastrectomy in 1948. An appendicectomy and a laparotomy for volvulus had been performed in the past.

On examination: General condition fair. Pale and in severe pain. Blood pressure 125/85 mm. of mercury, temperature 97°, pulse 130. Chest bronchitic.

A diagnosis of perforated stomal ulcer was made and intravenous morphine was given to relieve pain. A Ryle's tube was passed and aspirated, and an intravenous drip of 5 per cent. dextrose in water commenced. Laparotomy was performed seven hours after the onset of pain. The abdomen contained much free fibrin-flecked fluid, with a B.Coli odour. The gastrectomy stoma, afferent and efferent loops and duodenal stump were all normal. The appendix had been removed. The peritonitis was found to be due to an acutely inflamed enterogenous cyst on the point of perforation in two places. The cyst was at the end of a short loop of duplicated bowel, similar in appearance to ileum, which opened into the back of the ascending colon 2 cms. above the ileo-caecal valve (Fig. I).

The cyst and abnormal bowel were excised, this presenting no difficulties as the anomaly was provided with its own mesentery. The defect in the colon was closed in three layers and the abdomen was closed without drainage. Following operation the patient was treated by drip and suction until bowel activity returned on the third day. He was also given penicillin, streptomycin and vitamins intramuscularly. Morphine gr. $\frac{1}{6}$ was given six hourly for the first forty-eight hours.

On this regime his condition steadily improved, although he suffered a partial dehiscence of the abdominal wound which was treated conservatively. He was discharged to convalesce sixty-three days after admission.

Investigations performed post-operatively: Haemoglobin 103 per cent.; white cell count 17,800 with 13,300 polymorphs (24th January, 1957). X-ray of dorsal and lumbar spine — no evidence of developmental abnormality (4th March, 1957).



FIG. III. The specimen sectioned.

Pathologist's report: The specimen consists of a piece of bowel 4 cms. long and 2 cms. wide ending blindly at one end in a cyst 6 x 4 x 3 cms. (Fig. II). The lumina of the cyst and the bowel are not continuous. The cyst was filled with pus when opened and it was found to have a muscular wall 0.5 cms. thick and a slightly ulcerated mucosa (Fig. III). Microscopically the bowel has mucosa of large intestinal type and muscular walls of normal thickness (Fig. IV). The cyst is lined by mucosa similar to that of an appendix and lymph follicles are prominent in the submucosa. The muscular walls are greatly hypertrophied (Fig. V). There is acute inflammation of the subserosa and a fibrinous exudate on the serosa.



FIG. IV. Photomicrograph of wall of reduplicated bowel. (x 15)



FIG. V. Photomicrograph of cyst wall showing lymphoid follicles in submucosa and very thick muscle wall. (x 15)

DISCUSSION

Duplications of the alimentary tract are not common, but have been reported most frequently in association with the small intestine. Two main forms are recognizable:

1. The tubular form, which may occur as a blind diverticulum or a double-barrelled intestine.
2. The spherical form or cyst.

It is interesting that the reported case should demonstrate both forms, thus suggesting their common embryological origin. Various theories have been advanced to explain duplication. According to Lewis and Thyng (1907) who studied developing embryos in the pig and human being, diverticula arise in the foetal gut and are prone to persist

as duplications. If such a diverticulum is pinched off from the main bowel lumen an enterogenous cyst results. Bremer (1944) observes that the developing gut, whilst originally solid, later undergoes multiple vacuolation. Normally the majority of these vacuoles coalesce to form the gut lumen and the remainder disappear. Rarely, supernumerary vacuoles persist giving rise to one or other of the variants of intestinal duplication. The theory that small intestinal duplication is a variant of Meckel's diverticulum is untenable, as it may occur in sites quite unrelated to the vitello-intestinal duct.

In 80 per cent. of cases, the lumen of the anomaly does not communicate with the normal gut. A duplication has a well-defined smooth muscle wall and is lined by alimentary epithelium which is not however necessarily similar to that lining the adjacent normal gut. Evans (1929) explains this by assuming that the anomaly is originally lined, like the primitive gut, by undifferentiated cells capable of developing into any of the various types of bowel mucosa.

Occasionally, especially in the cystic forms, intraluminal pressure destroys the lining mucosa or results in squamous metaplasia. In the case of a cyst, the contents vary with the character of the mucosa. When the mucosa is gastric in type, the contents are highly acid and tend to cause peptic ulceration. When the mucosa is colonic, the contents are alkaline and of a viscid nature.

Most duplications are intimately related to the wall of the normal gut, making their dissection difficult or impossible. This distinguishes them from the mesenteric cysts which are lymphatic in origin and easily separated from their surroundings.

Enterogenous cysts may be submucosal, intermuscular, subperitoneal or intramesenteric.

Symptom-producing duplications usually make their presence felt in infancy or early childhood, 65 per cent. of them in the first year of life. The symptoms may be placed into the following categories:

1. Obstruction. This takes the form of recurrent attacks of abdominal pain and vomiting due to partial intestinal

obstruction caused by pressure of a duplication on the adjacent bowel. Obstruction occurs when the duplication becomes distended.

2. Distention. The duplication can become so distended that pain is caused.
3. Infarction. A distended duplication lying between the leaves of the mesentery, may obstruct mesenteric blood vessels causing infarction of the adjacent intestine. Clinically, there are signs of peritoneal irritation and melæna in these cases.
4. Ulceration. When a duplication is lined by gastric mucosa, peptic ulceration may occur in the adjacent normal mucosa. Such ulcers are liable to the usual complications of perforation and hæmorrhage.
5. The duplication may be the starting point of an intussusception or a volvulus and it is interesting to recall that the present case had been operated on for an unspecified type of volvulus. Cystic duplications are sometimes palpable as mobile non-tender abdominal masses.

X-ray investigation may reveal the lesion as a soft tissue shadow, especially when a large cyst is present. As duplications only communicate with the normal gut lumen in 20 per cent. of cases, barium will not often fill the lesion, but may show displacement of neighbouring normal structures. Radiology also occasionally demonstrates an associated malformation of the vertebral column, either a spina bifida or a hemi-vertebra.

Microcytic anaemia from repeated occult bleeding is a feature of some cases. If the duplication is causing symptoms the treatment must be early surgery to avoid the complications mentioned above. The intimate association of the majority of duplications with the wall and the blood supply of the normal gut makes dissection hazardous. In these cases resection of the duplication together with adjacent bowel is preferable. In other cases, marsupialization may be the treatment of choice.

The present case is assumed to have arisen when the enterogenous cyst, distended with its

own secretion, became involved in a blood-borne infection. It was fortunate that the duplication had its own blood supply and was quite distinct from its surroundings as this made its operative removal a simple matter.

SUMMARY

A case of intestinal duplication which presented as an acute abdominal emergency is reported with the purpose of drawing attention to the condition in its various forms. The embryology and common symptomatology is also discussed.

ACKNOWLEDGEMENTS

I would like to thank Mr. J. A. Pocock for allowing me to treat this case, and Dr. O. Lloyd for reporting on the specimen.

The Medical Photographic Department of the University of Bristol provided the photographs.

REFERENCES

- BREMER, J. L. (1944), *Arch. Path.*, vol. 38, page 132.
EVANS, A. (1929), *Brit. J. Surg.*, vol. 27, page 34.
LEWIS, F. T. and THYNG, F. W. (1907), *Amer. J. Anat.*, vol. 7, page 505.

THE GEORGE ADLINGTON SYME ORATION*

JESTING PILATE

By THE RIGHT HONOURABLE SIR OWEN DIXON, G.C.M.G.

Chief Justice of the High Court of Australia

THE purpose of our assembling here is to honour the memory of a very great surgeon and a highly distinguished man. To many of you Sir George Syme must be but a name; for it is 28 years since his death. But there are those here in whose memories he must stand out clearly and who can still see his figure and feel the peculiar strength of his modest personality. He would not, I think, have chosen a lawyer to recount the incidents of his great professional career in peace and war, or to describe his contributions to surgery. Indeed it is not a thing I am qualified to do. But I am among those who had the happiness of knowing him and, as it chanced, it was in a very different aspect of his life.

He was one of those who formed the Wallaby Club, that institution, apparently peculiar to the life of Melbourne, which has given so much enjoyment to men who will walk and are practised in one or other or both of the arts that make up conversation — listening and talking. He joined the Club in 1894, the year of its foundation. It was over thirty years later that as a junior member I walked and talked with him. That was in the last few years of his life; but that and an earlier, though perhaps less familiar, acquaintance with him left a vivid memory of a strong and active mind accustomed to definite thought precisely expressed.

In the chronicles of the Club he is recorded as one of the best Wallabies that have ever been. He is described as a good listener, a man of few words but one who could talk well on any subject, if in the mood. It is noted that he was rarely seen to smile, even at the jests and quips of certain men whose reputation for humour has survived. A verse was written by one member — “When sombre Syme is convulsed with laughter the millen-

nium is near.” But he was not a man to be convulsed by anything. His responses seemed always to be those of the mind, not of the emotions.

I remember that in his conversations with me he spoke more than once of the future of medicine as a learned profession, and the importance to humanity of its being able to maintain the lofty ideals of duty and service which the past had bequeathed and to fulfil them. He spoke thus because, as he said, he knew that the Bar, of which I was a member, inherited a similar tradition which it should be our trust to hand on without impairment. Few who fulfil their destiny, as he did, in devotion to a learned profession altogether escape these anxieties about its future in the hands of those who follow. But if he shared this undeniably human apprehension, he himself nobly fulfilled the debt to his profession of which Bacon speaks and, in the quaint Elizabethan language of that writer, Syme was able to visit and strengthen the roots and foundation of the science itself and thereby did grace it in reputation and dignity, also amplifying it in perfection and substance.

The roots and foundations of law and medicine are far apart. But their techniques, like much else in the practical application of knowledge and in the conduct of human affairs, are governed by constant preoccupation with questions to which no answer is known. In each action awaits upon judgment. But seldom does the law present that insistent demand for immediate action that medicine must so often do. Law seldom calls for that intuitive judgment based on an anterior equipment of knowledge and of great experience which represents the highest example of the power of immediate inference to the particular by untraceable steps in inductive reasoning from the most general. The habit of mind that is formed by the constant need of making judgments of such a kind may not be a good qualification for an expert witness.

*The Twentieth George Adlington Syme Oration delivered on 20th August, 1957.

Analytical methods of thinking and an appreciation of dialectical distinctions help the expert witness at least to make a good showing. But it may be some comfort to the medical expert witness to compare the case of the soldier. When Field Marshal Lord Kitchener was criticised on one occasion by the holder of a high office, once a lawyer, for his supposed failure as a Minister of War, a distinguished general who had served under Kitchener replied: "Sir, he excelled in making correct decisions instantly in a crisis on which all might depend, not in arguing them out with lawyers who had taken to politics."

The general who defended the Field Marshal was of course right in treating the two methods as antithetical. But in whichever of the two you have been trained you will never suppress the desire to be better informed whenever you must make a decision for which you feel any heavy responsibility.

The legal system would seem to assume always that the course of human affairs is discoverable, that there is time and opportunity for inquiry, that the connexion of events or causes can be ascertained, that principles of conduct can be determined by forms of reasoning and that intentions of men and documents are neither so fleeting nor so unreal as to be proof against a dialectical search. In this the law adopts a standpoint that of necessity must be denied to those whose responsibility it is to act at the call of events. In their case the need of knowledge often is no less. They would wish in matters of consequence to know as much of the situation with which they are about to deal, and to know with as much certainty, as a judicial inquiry is considered to assure. But they cannot. More often than not they must do their best, profiting by whatever information they already possess and summoning experience to their aid, but using, in place of the prolonged search after truth of the judicial process, their own intuitive judgments. The contrast in method may be striking, but the contrast is not limited to method. The Courts are not, as is a man who is called upon to decide upon action in general affairs, concerned with a general situation defined neither in its ambit nor its consequences. The Courts in their way seek truth only upon some narrow or restricted question defined in advance by the law, a question which is

submitted to them because it supplies the standard of decision between the parties. A much wider field must be covered in great affairs of state for there can be no limit to the considerations that may be relevant or the consequences that may ensue. Indeed, that must often be true in the field of medicine. It is of the difference, real or supposed, between these demands for what it is easy to call "truth" and of the limits of both of them that I speak.

It is a mistake to look at the legal system as if it worked only in or through the Courts. Countless people are governed as to their rights and liabilities by the advice they receive. In more important matters the advice may come from men qualified to give it, that is to say solicitors or counsel, unless the question be one of income tax; for that question, we have been told, is at present a mystery impenetrable by all save accountants. In minor things the advice may come from less qualified sources. But always there will be some situation of which there must be a precise and accurate knowledge before anyone can be sure of the rights or liabilities. But these advisers seldom have the time and never the machinery used by the Courts available to them.

The procedures and practices of the Courts are directed to the elucidation in detail of complex situations in which the rights or liabilities of the litigants have their source. By a complex situation I do not refer only to physical occurrences, although to find what happened as a matter of physical fact often may mean a complicated investigation. I refer as well to some of those entanglements in which the modern man of affairs is enmeshed or enmeshes himself, compounded of statutes, regulations and documents of all sorts, to say nothing of devious procedures and indefinite understandings. But there is too another cause of complex situations on which men's rights depend. It is one that is met with again and again. The law sets a standard or test which seems just and right in the abstract but cannot be applied in disputed cases except at the cost of an investigation often both uncertain and burdensome. For instance, it seems proper enough that a man's will should not stand if he has insufficient mental capacity to make one. But many here will know how the ramifications of an in-

quiry into the testamentary capacity of a deceased testator seem limitless and the result correspondingly uncertain.

To take another example: It seems right that a man should not obtain a patent for an invention unless it involves an inventive step. But suppose you are in the field of electronics. Some slight improvement is made and the question is whether it suffices as an inventive step to support the monopoly which a patent gives, one conceivably of definite commercial value. The question might be an easy one for a physicist if he also possessed an adequate knowledge of patent law. But even such a man, if you found him, would be called upon to study the specifications of previous patents and the like and make himself familiar with the state of the applied art. But if the question were litigated in the Courts, as failing all else it must be, it would engross the minds and talents of many people for many days. They might as a result remain better informed, but otherwise the sum of human wisdom or knowledge would be no greater than it was before this expenditure of money and effort. All this, however, is traditionally justified as part of the pursuit of truth and justice.

In medicine the purpose of an investigation is less abstract. The interest of a litigant in truth and justice can be understood, for he is seldom cynical enough to distinguish them from success in his suit. But in medicine there seems no parallel to this confusion of ideas. The search for diagnostic truth may be elaborate and costly but it is made so that the best can be done for the patient. One may perhaps be permitted to suppose that much is done with a view to eliminating possible causes although their existence is not regarded as in the least probable. No doubt that is more scientific than the adoption of an intuitive judgment however strengthened it may be by antecedent knowledge and experience. In the same way Courts of Justice are wont to exhibit so much disquiet in the presence of an unexcluded hypothesis that sometimes much time and money is expended on adducing evidence to exclude it and so to strengthen the conclusion to which all else seems to point.

For some eighteen years I played my part as counsel at the Bar, that is to say I was a humble auxiliary in the Courts that seek day

by day in case after case to come at the truth both of the law and the facts in the faith which we are all taught that that is justice.

Even the humblest auxiliary in such a process comes to feel that he has some share in the responsibility for the outcome of the cases in which he has a part. General reflections are for the most part denied to him by the insistence of more particular demands on his often over-taxed mental powers. But he rarely escapes altogether searchings of heart about this or that criterion of right that has ruled the fortunes of the parties to some case and the attainability of any definite or certain answer to the question whether the test has been satisfied; or, in the oversimplified terms forming the currency of unanalytical minds, whether the truth of the matter has been rightly defined and can be found.

With one perhaps less fundamental matter I became much impressed. It was the view that it is not the fault of the Courts of law that difficult and uncertain inquiries must be undertaken. The nature of the inquiry, more often than not, is made inevitable because the law, guided by supposed considerations of justice, has provided some test of the rights or liabilities of the parties which throws open a wide and uncertain field, a field a survey of which may not necessarily produce any clear or certain answer.

Next followed some years on the bench with little "rest from long debate of wrong and right." It was in a Court which I had watched even as a student and with which I had grown familiar. No very profound study of the Court, as I first saw it, was necessary to teach the lesson that the real weakness of powerful and confident minds strengthened by dialectical gifts and at the same time accustomed to the responsibility of decision lies in the tendency to work their way to a conclusion rather than to stop to inquire. The Court comprised learned men of high intelligence and the great Sir Samuel Griffith was the Chief Justice; but to witness the proceedings was to learn this lesson. So it was not only because of its wit but because of the penetrating truth of the implication it contained that the well-known reply made by Coldham, a distinguished counsel of the time,

to the comment of the Chief Justice on his argument has passed into legal currency here. I mean the Chief Justice's comment that after listening to Coldham at length the Court was no wiser and Coldham's reply — not wiser but better informed. But the fault, if it be a fault, is found in the greatest men and, if they be administrators fortunate in their intuitive instincts, it is often counted among their most admired qualities.

The war brought me opportunities of seeing this and much else beside. I presided over more than one body whose purposes were as antithetical to those of the Courts as could be imagined. Yet underlying the work of these bodies, if it were possible to philosophise about it, which it was not, you would discern the same dilemma. You must act but you must know. Yet action can seldom wait upon full inquiry. But I shall not stop to take dull illustrations from the field of war-time administration in Australia.

I was soon to be transferred to a much wider scene where at close range I could see for myself men in the highest places making momentous determinations. It is to that experience I shall now turn for parallels. In Washington, by June, 1942, when I took up my duties at the Legation, I found that there had been assembled men of the highest talent to represent the Allies in the conduct of the war. There were the combined Chiefs of Staff consisting of the American Joint Chiefs of Staff and of the British "Joint Chiefs of Staff in Washington." There was all the organization controlling supply and production, transport by sea and air, and much else ancillary to the war as, for example, economic warfare and political warfare. At the summit was the White House, containing the President and his closest counsellors, and there from time to time came Mr. Churchill, as it still seems natural to call him, to consult with Mr. Roosevelt.

Diplomatic representation between allies engaged in war wears a different aspect from that of peace and the part played by Lord Halifax and those forming his Embassy was significant in the extreme. The foreign service of any country ought to keep its government informed about the various countries where it has posts. Reporting upon the policies that are pursued, the developments that occur and the persons likely to in-

fluence the course of events is part of the routine of diplomatic life. There is nothing sinister about this, although it is viewed with deep suspicion by Communist countries. It is commonly believed that as a result of the practice both the Foreign Office of Great Britain and the State Department of the United States possess a wealth of information available for the guidance of statesmen on any aspect of foreign policy. But it is one thing for information to be available and it is another thing to master it. A favourable opinion of one who did the state some service and gained not a little of his experience in Washington was that the minds who decided could never be adequately informed, and the minds that were adequately informed could never be permitted to decide. The system in which democracy puts faith means that those in whom resides the supreme power must accept responsibility for the decision of all questions known to be of high importance to the state. There may be a specialist perhaps far down the line with the knowledge at his finger tips which would enable a man who had the mind to exercise a completely informed judgment and reach a wise conclusion; and it may very likely be that that comparatively lowly officer has the mind. But it is not in him that democracy places its faith. He can but report. The decision will be made at the top and between him and that pinnacle there may be many steps. His views may command assent as they go up the line. Satisfactory as that may be to him, it is still consistent with the thesis propounded to me that in great matters the power of decision and the complete possession of the available knowledge seldom reside in the same person.

For my instruction a contrast was once drawn between the methods as Foreign Secretary of the late Viscount Simon and those of the late Mr. Arthur Henderson who also occupied that office. Sir John Simon, as Viscount Simon then was, being confident, as well he might be, of his powers of rapidly assimilating the contents of documents, would decline to decide until he had seen the files. On some European questions the Foreign Office could if they chose supply him with relevant files stretching back to Castlereagh's time. He sought to form an intelligent and informed judgment of his own. Days were consumed in doing so and one

question trod on the heels of another. Mr. Arthur Henderson on the contrary had no illusions about his capacity to proceed in such a fashion. But he believed that he knew men. Accordingly he sent for the man whom he had discovered to be the author of the report and questioned him. If he inspired him with confidence he accepted his views. He was regarded as a successful Secretary of State for Foreign Affairs. That view of Sir John Simon's occupancy of the office has not yet been universally accepted.

You all know with what an immense background of knowledge Sir Winston Churchill came to the leadership in the War. It must have made no small contribution to his strength. We have read lately of the difficulties which he occasioned his Chiefs of Staff by his many incursions into their domain. These complaints are not new: they were made, but not very loudly, during the war. General Marshall used to tell of a night which Harry Hopkins and he spent at Chequers. He had driven over from a church parade at which he had read a lesson containing Biblical names which he had barely surmounted. Churchill greeted him by a reference to the fact, saying that he knew through the British Secret Service, the efficiency of which Americans never sufficiently acknowledged. For some time the real purpose of the visit was ignored and then both Hopkins and General Marshall found themselves resisting one proposal after another of which they had not before heard and the source of which was obviously not the Chiefs of Staff. There were of course other things to discuss. At length the General stole off to bed, only to be awakened in the small hours of the morning by Hopkins with a request to provide an answer to a new suggestion from Churchill. General Marshall gave him a military answer which Hopkins took down to the Prime Minister. An hour or more later General Marshall was again awakened by Hopkins with still another problem from Churchill. "That has a political aspect, so you can answer that yourself without waking me," said the General. It is a simple story but it gives a vivid impression of the indefatigable energy of mind and the imagination and resource which Churchill devoted to that end which I heard him once express as "to pull that fellow Hitler down." Mr. Roosevelt once said to me, "I am worried

about Winston. He has been ill and from morning to night he never lets his mind leave the war. I find relief in the domestic affairs of this country and in certain hobbies" (which the President named) "but Winston does nothing but think of the war." I did not feel that I would have had it otherwise. But is it not apparent that here, in affairs of the greatest magnitude, you have as an indispensable quality of a courageous and vigorous war leader, eagerness for action, but you have it met again and again by the controlling force of material things, physical facts and organizational considerations of which his knowledge was inadequate but which it was within the province of the Chiefs of Staff to assemble and to know. That he would give way when he found that men in whose character and skill he trusted opposed his views there seems to be little doubt. Indeed I have seen an instance of it. At an early stage of planning for the invasion, and it went far back governing even the use of materials in production, there was a large conference at the British Embassy over which Churchill presided. The Director-General of the British Supply Mission insisted that the plans did not provide for enough military vehicles and asked that the matter should be reconsidered. To this the Prime Minister gave an immediate refusal, amplified by characteristic protests against the over-use of military vehicles. He spoke of the need of steel by the Navy, of the objections to disturbing the division of steel that had been arranged and again of the misguided reliance on military vehicles for everything. Suddenly there was an intervention from Field-Marshal Sir John Dill whose contribution to the success of the Allies cannot be overrated, but who seems to have had his own difficulties with Churchill during the period when the situation looked so desperate. He said, "Sir, I remember that you and I were in France early in June, 1940, and the panzer divisions were coming down. I do not think that we took the same view of military vehicles then." Churchill turned to his secretary and said, "Send a telegram to recommit the question of military vehicles." I do not think that such an incident could have taken place in the case of Mr. Roosevelt. On every side it would be too much out of character.

Both men carried authority into their dealings with men but Churchill seemed naturally

to resort to command while Roosevelt seemed instinctively to seek to persuade. I fancy too that Roosevelt seldom came to feel misgiving about his own intuitive judgments. His knowledge and understanding of the United States was doubtless very great, he was very much alive to his own political environment and his immense success on the domestic scene has often been publicly ascribed to his gift for correctly assessing a situation and providing a solution, one of course that appealed to his own public. But foreign policy and war make other demands. No doubt theoretically the direction which foreign policy takes is in the hands of a country's government. It is a pleasing hypothesis. But in fact in the five or six years before war broke out the initiative in foreign affairs was in Hitler's hands. To deal with the situations he brought about Roosevelt and his counsellors must have felt the need of more and more information. Churchill told Roosevelt that the war would be called "The Unnecessary War." His reasons comprised the mistakes and failures on the side of the Allies that preluded it, the absence of America from the League of Nations, the unpreparedness of that body to employ force, the lack of early resistance to Hitler. But will the verdict of history be that the root cause of the avoidable war was German lack of an informed understanding of the true situation and Hitler's preference for intuitive judgments?

The question presupposes that an appeal to reason might have been possible. Perhaps it was not. But if the tacit assumption that reason governs such things is a fallacy, it is not an ignoble one and may indeed be the consequence of the tradition in which we have been nurtured. The great service which law, particularly English law, has done for society is a commonplace. But among other things it has produced habits of thought which lead us to think that all human conflicts will yield to reason and that if any contentious situation is laid bare in detail by full inquiry and investigation in the manner of the law courts, further controversy must be stilled. We therefore look hopefully for the ultimate success of the long-sustained attempt to reduce the relation of nations to the rule of law and the submission of international conflicts to a form of judicial investigation. In so doing we overlook the fact that fear, mutual fear,

plays an enormous part in the enmities of nations of comparable strength. Doubtless there are many who cling to Churchill's paradoxical hope. "It may be," he said not so long ago, "that we shall by a process of sublime irony have reached a stage in this story where safety will be the sturdy child of terror and survival the twin brother of annihilation." If this be right no doubt it is conceivable that the rule of law may be accepted as an alternative.

But there is another aspect we overlook too. It is that little analogy can be found between the sources of conflict among nations and the subject matter of our judicial proceedings. Judicial proceedings are directed to a defined end. Early in this paper I spoke of the want of exactness of the definition, that is to say of some of the tests of rights and liabilities. But without a defined end every investigation must finish in the air. To me there is a lively contrast between the work to which I was required to address myself in the dispute between India and Pakistan over Kashmir and, on the other hand, the work which in the High Court of Australia we do almost as a matter of routine in deciding issues affecting the States or the Commonwealth or both. It is right to say that when the governments of India and Pakistan found that my approach to the solution of that dispute was dictated rather by my judicial experience than by that of my temporary venture into diplomacy at Washington, I received as much countenance and assistance from each as I could ask. The adoption of the method did, I believe, very materially increase the possibility of a solution. It may be that the long familiarity of the sub-continent with the conceptions of English law and the administration of British justice were not without its helpful influence. But the countries were not in dispute about the application to the controversy of a provision of an overriding law, the obligatory force of which they both acknowledged. They were two independent nations of the Commonwealth subject to no such law. The basis for a judicial decision did not exist and the dispute remains unresolved. The seven governments of Australia are established by a constitution which regulates their mutual relations and defines their respective powers. It is the duty of the Court over which I have the honour to preside to apply the law which

results from this constitutional instrument and by tests thus provided we decide whether legislative or other powers have been exceeded or whether one government is liable to another.

Unlike men responsible for immediate action we have all the advantages which dialectical discussion can give; by the ordinary legal process relevant facts and circumstances can be made to appear, and we have time, if not leisure, in which to reach our decisions and prepare our reasons. If truth is an attribute which can be ascribed to a purely legal conclusion, it should be within our reach.

These are very different conditions from those in which the man of action is often

placed. For the strength of such a man lies in his anterior equipment of knowledge and in an experienced and wise but courageous intuitive judgment. The native hue of resolution cannot be sicklied o'er with the pale cast of thought. Enterprises of great pith and moment must not, with this regard, their currents turn awry and lose the name of action.

But it is not to Hamlet but to Bacon's Essay on Truth that I have turned for the title of this paper.

"What is truth?" said jesting Pilate, and would not stay for an answer." I have not forgotten that when Pilate said this he was about to leave the judgment hall.

HYPOTENSION IN NEUROSURGERY

By S. V. MARSHALL

Sydney

VASCULAR hypotension has been known for many years to lessen bleeding and to improve visibility during surgical operations. Thus the reduced haemorrhage associated with the use of chloroform, spinal analgesia, and to a lesser extent bromethol (Avertin), was welcomed and even demanded by some surgeons. Generally, however, the need for keeping blood pressures around normal levels during operations was widely recognized, so that any fall was promptly countered by vasopressor agents, intravenous fluids, or blood transfusion. The threat of shock and peripheral vascular failure was viewed with great concern, and vigorous measures were directed to their prevention and treatment.

Gardner (1946) initiated a startling challenge to this fundamental concept. On the basis of the observation that bleeding progressively lessened during neurosurgical operations he advocated and practised the substantial preliminary abstraction of blood by arteriotomy in such cases. Peripheral vaso-constriction resulted, and so operative blood-loss was much reduced, but the intact compensatory mechanisms tended rather soon to restore normal conditions. Nevertheless, a relatively small additional haemorrhage could now cause profound hypotension, which might lead to irreversible shock, despite the re-infusion of the collected blood. Various other hazards, including air-embolism, thrombosis and even gangrene, bedevil the procedure, and these together with the onerous technique involved have not encouraged its extensive use.

Next, Griffiths and Gillies (1948) introduced their technique of total spinal analgesia, which by paralysing the sympathetic nervous outflow caused widespread vasodilatation and hypotension. The results obtained were considered to justify the procedure, despite the known hazards of spinal analgesia, immediate and remote. Later on Bromage (1951) employed the more difficult

technique of high epidural analgesia for the same purpose, the lessened possibility of neurological complications being its chief recommendation.

Meanwhile a more determined onslaught on established notions of physiological propriety had begun when Davison (1950) and Enderby (1950) first described the clinical use of certain methonium compounds for hypotensive purposes. These agents, too, caused peripheral vasodilatation as well as other undesirable side effects by blocking impulse transmission at all autonomic ganglia. Thus automatic compensatory mechanisms were virtually abolished, and so any further adverse factor such as impaired ventilation or haemorrhage could be disastrous. Further, the prolonged action of the methonium derivatives necessitated much expert after-care. A residual liability of vaso-motor control might persist for anything up to forty-eight hours, while blurring of vision, attributed to paralysis of accommodation, was often troublesome and alarming. It is possible that this latter effect might have been due, in part at least, to a central hypoxia affecting the visual cortex.

Despite these ominous portents, the novelty was received with enthusiasm. Ordinary prudence and scepticism were apparently discarded by many surgeons and anaesthetists, until induced hypotension was demanded and applied in all sorts of absurd circumstances — e.g. for tonsillectomy. The rapidity and ease of its production by simple intravenous injection greatly favoured its uncritical use, and its presumed innocuity was further emphasized by the misnomer "controlled hypotension." Nevertheless, serious doubts about the wisdom of the procedure still persisted in various quarters, and adverse comment began to accumulate.

However, the clinical introduction of trimetaphan camphorsulphonate (Arfonad) by

Nicholson *et alii* (1953) significantly improved the situation. This agent, too, acts by ganglionic blockade and perhaps a direct vaso-dilator effect as well. It is given intravenously as a 0.1 per cent. solution (1 mg. per ml.) by the intermittent-drip method. Being rapidly eliminated its action is transient, and so it does offer prospects of real controllability and fewer sequelae. Individual requirements vary considerably but as a rule sixty drops (4 ml.) per minute will reduce the systolic blood pressure to about 80 mm. of mercury within three or four minutes. Thereafter the drip rate is slowed or periodically interrupted, frequent blood-pressure readings being the essential guide.

Thus it seemed that induced hypotension could be made reasonably safe. This complacency, however, suffered a rude shock when Hampton and Little (1953, a and b) analyzed a composite British and American series of nearly 28,000 cases. Methonium compounds had been used in a majority of these, but high spinal analgesia and arteriotomy figured significantly, and even the comparative newcomer Arfonad was included. In the series there were 96 deaths or 1 in every 291 cases, many being attributable to the method, while relevant non-fatal complications of varying severity occurred about once in every 31 cases. These figures indeed emphasized the hazards of induced hypotension. At this time, too, one of the originators, Davison (1953), stressed its risks and very restricted applicability. Since then a better appreciation of its utility and dangers has developed, culminating in the excellent monograph of Little (1956) which defines the indications and limitations with admirable precision.

From the foregoing 3 basic criteria would seem to emerge:

1. Induced hypotension should not be employed in the absence of a direct indication for its use.
2. Instead of being the first resort its use should always be complementary to other measures for lessening haemorrhage.
3. A careful selection of cases is imperative, in view of the greater anoxic risks

in malnutrition and anaemia, atherosclerosis, myocardial deficiency and advancing years.

In neurosurgery there are few absolute indications for the employment of deliberately induced hypotension. These are operations in which massive haemorrhage might occur, as with meningiomas, haemangiomas, and intracranial aneurysms (Anderson and McKissock, 1953). In these the flexibility of Arfonad makes it the hypotensive agent of choice. To a large extent its dosages can be regulated to cover immediate needs, apart from which the blood pressure may be allowed to rise in order to minimize hypoxic dangers, as well as to facilitate proper haemostasis, especially before wound closure. Otherwise simpler methods of procuring relative ischaemia should be utilized.

Suitable posturing and adequate lung-ventilation are the most important of these. A moderate anti-trendelenburg position will frequently improve access and visibility to a striking extent. So, too, the sitting posture, which provides a virtually ischaemic field for operations on the upper part of the spine, the posterior cranial fossa and even the Gasserian ganglion. In contrast, the prone position will often cause much venous engorgement, although proper support of the shoulder and pelvic girdles will greatly improve matters. Here a most useful alternative is the lateral position, which ensures free breathing as well as the unrestricted venous return of blood to the heart. Obviously the hypotensive drugs have no place in the relief of bleeding due to postural strangulation; similarly they are absolutely contra-indicated when the patient is sitting. Their use is highly questionable also when anti-trendelenburg tilting is employed, although this may become necessary in resistant subjects.

Proper internal ventilation is the other means by which excessive intracranial tension and bleeding may be corrected. Even with adequate oxygenation hypercapnia will cause cerebral vaso-dilatation, increase of brain-volume and excessive arteriolar oozing. A large variety of factors is involved in the development of this situation. Premedication may be too heavy and narcosis too deep, leading to shallow breathing, so that despite lavish gas flows ventilation is inadequate, as

often seen with open-circuit techniques. Undue rebreathing may occur with semi-closed techniques, especially where no distal check-valve is located in the delivery tubing. Excessive dead-space or failing soda-lime may vitiate the efficiency of closed-circuit techniques. Kinked endotracheal tubes or their endobronchial placement will further aggravate the situation. The striking improvement that follows the correction of these defects is unquestionable. The brain sinks back, the oozing ceases, and surgical equanimity is restored. How absurd, then, is it to give some potent vaso-depressor agent in such circumstances when a simple improvement in anaesthetic technique will suffice!

Where induced hypotension is to be employed, however, suitable preparations must be made, and adequate facilities and assistance provided. It is beyond the capacity of one person to handle the anaesthetic, the hypotension, and the resuscitation single-handed. All apparatus must be in perfect working order and supplies of blood ready for immediate use. Above all there must be perfect liaison and understanding between surgeon and anaesthetist.

SUMMARY

1. The development of induced hypotension is discussed and its hazards briefly outlined.

2. The superiority of trimetaphan camphor-sulphonate (Arfonad) for hypotensive purposes is stressed.
3. The restricted utility of induced hypotension in neurosurgery, and the value of simpler alternatives for the control of bleeding, are indicated.
4. The necessity for adequate facilities and assistance, as well as for complete liaison between surgeon and anaesthetist in the conduct induced hypotension, is emphasized.

REFERENCES

- ANDERSON, S. and McKISOCK, W. (1953), *Lancet*, vol. 2, page 754.
- BROMAGE, P. R. (1951), *Anaesthesia*, vol. 6, page 26.
- DAVIDSON, M. H. A. (1950), *Lancet*, vol. 1, page 252.
- (1953), *Anaesthesia*, vol. 8, page 255.
- ENDERBY, G. E. H. (1950), *Lancet*, vol. 1, page 1145.
- GARDNER, W. J. (1945), *J. Amer. med. Ass.*, vol. 132, page 572.
- GRIFFITHS, H. W. C. and GILLIES, J. (1948), *Anaesthesia*, vol. 3, page 134.
- HAMPTON, W. J. and LITTLE, D. M. (1953a), *Arch. Surg. (Chicago)*, vol. 67, page 549.
- , — (1953b), *Lancet*, vol. 1, page 1299.
- LITTLE, D. M. (1956), "Controlled Hypotension in Anesthesia and Surgery." Springfield, Illinois, Charles C. Thomas.
- NICHOLSON, M. J., *et alii* (1953), *Anesthesiology*, vol. 14, page 215.

THERAPEUTIC APPLICATIONS OF HYPOTHERMIA

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HYPOTHERMIA has been described by Swan as "the physical state of a homeothermic individual in whom the body temperature is below the normal range for that individual." For man any temperature below 36°C represents a state of hypothermia.

In this paper the indications, management and complications of hypothermia for therapeutic purposes will be discussed. It is not proposed to refer to hypothermia for surgical purposes except that surgery may be an incident in the general management of such cases.

So far our experience of therapeutic hypothermia is limited and has been confined to the management of cases of cerebral aneurysms, head injury, post-operative hyperthermia and one case of thyroid crisis.

For centuries cooling has been employed as a physiotherapeutic measure although there was no significant lowering of the internal body temperature as the depression rarely exceeded 1 to 2°C.

During the 18th and 19th centuries there were a number of reports of cooling due to accidental exposure. Reinke (1875) made observations on five inebriated individuals who had been exposed to cold. The two survivors had a body temperature of 25° and 27°C respectively.

Scientific interest in cooling was aroused by Temple Fay who observed that primary and metastatic carcinoma rarely developed in areas of the body where lower temperatures prevail, e.g. the extremities. He first developed a technique for local cooling of tumours and later employed generalized cooling, reducing the patient's temperature to approximately 30 to 32°C for periods of twelve hours to eight days (Smith and Fay, 1939; Fay, 1940). Fay's initial enthusiastic reports were later qualified, but it appears that many of the less differentiated growths did regress for variable periods. In addition, a reduction of pain was achieved which frequently outlasted the treatment for weeks and months

and resulted in a decrease in the use of opium alkaloids and sometimes chordotomy could be avoided. Fay was the first to appreciate that cooling could be obtained safely only when the body's defences of shivering and vasoconstriction had been overcome. He achieved this by heavy doses of barbiturates.

Fay (1945) also described the management of head injuries by cooling.

Talbot (1941) suggested the term hypothermia and described in detail its use in the management of cases of inoperable carcinoma, leukaemia, schizophrenia and morphine addiction.

The work of Fay, Talbot and others stimulated a considerable amount of research into experimental hypothermia and its physiological effects.

Bigelow (1950) again drew attention to the clinical aspects of hypothermia by demonstrating the reduction in metabolism and oxygen requirement of hypothermic dogs. Bigelow suggested the possibility of arrested circulation under hypothermia and thus commenced the era of hypothermia for surgery. Since then a great deal of work has been produced on the techniques, physiology and pathology of induced hypothermia for surgical purposes where interruption to the circulation of the central nervous system is envisaged. In particular, most attention has been paid to hypothermia for cardiac surgery where abnormal physiological conditions already obtain.

Although in recent years the possibilities of prolonged hypothermia for therapeutic purposes have been realized by Swan (1954) and others, and much experimental work has been done, no adequate clinical report has appeared since Talbot's excellent paper in 1941.

INDICATIONS FOR THERAPEUTIC HYPOTHERMIA

I. Anoxia of vital organs

It is well established that hypothermia reduces the metabolism of all organs (Penrod,

1949; Bigelow, 1950). At normal temperatures the central nervous system is the least tolerant of hypoxia while at low temperatures the heart will tolerate much shorter periods of oxygen deprivation than the brain. Other organs such as the liver and kidney also appear to tolerate prolonged periods of anoxia when hypothermic.

(a) The central nervous system

Bigelow (1950) has demonstrated that at 30°C brain metabolism is 55 per cent. of normal, at 28°C it is 40 per cent., and at 22° it is 15 to 25 per cent. of normal.

In addition Rosomoff has shown, in dogs, a decrease in cerebral blood flow, an induced compensated hypotension (Rosomoff and Holaday, 1954), a progressive decrease in brain volume and intracranial pressure as the temperature falls (Rosomoff and Gilbert, 1955).

Conditions of the central nervous system likely to benefit from hypothermia are those which are associated with a reversible hypoxia. These include:

- (i) Raised intracranial pressure.
- (ii) Cerebral oedema.
- (iii) Head injuries — especially of brain stem.
- (iv) Conditions associated with vascular spasm, e.g. subarachnoid haemorrhage.
- (v) Interruption to a major cerebral vessel — surgical, thrombosis, embolism.

Early anatomists claimed that the perforating vessels of the brain were all "end arteries" (Shellshear, 1920; Beevor, 1909). Recent investigators, however, have described anastomoses among precapillaries and capillaries of the terminal areas of distribution (Van der Eecken and Adams, 1953). These anastomoses may be useful in shunting blood from one source of supply to another, provided they have time to open up. By reducing metabolism and hence disproportion between supply and demand, this can be achieved.

Rosomoff (1956) has demonstrated that ligation of the middle cerebral artery always results in infarction in the normothermic dog whereas if the animal is at 22°C either no infarct or a minimal microscopic lesion results.

This work is substantiated by our limited experience with patients who have had surgical interruption of major cerebral vessels provided the temperature is 28°C or lower at the time of ligation and provided subsequent hypothermia continues for at least twelve hours.

The greater part of my experience with therapeutic hypothermia has been in cases of subarachnoid haemorrhage where the main permanent disability is a result of spasm of vessels rather than haemorrhage into brain. From the surgical point of view the patient who has had a recent bleed is a very difficult problem, particularly if the patient has a second or third haemorrhage in a short period. Such cases are usually inoperable and the outcome is likely to be fatal. At this stage cooling for a variable period of twelve to twenty-four hours can convert the hopeless case to a state where operation is possible.

Case 1

R.M., a male aged 26, was admitted with subarachnoid haemorrhage due to ruptured aneurysm of right anterior cerebral artery. Patient was rather obese with a blood pressure of 150/80 mm. of mercury and normal renal function tests.

Twenty-eight days after the acute episode he underwent craniotomy and ligation of the aneurysm. During the clipping of the aneurysm it was necessary to place a clip across the left anterior cerebral artery and post-operative angiography showed non-filling of both anterior cerebral arteries.

For the operative procedure his oesophageal temperature was 30°C. After the operation he was maintained at 28°C for four hours, at 30°C for a further six hours and at 34°C for the subsequent twelve hours. For the subsequent four days intermittent active cooling was employed to counteract the tendency to hyperthermia and his temperature was maintained at about 37°C. His post-operative course was uneventful except for an attack of grand mal on the fifth day.

He was discharged home eighteen days after operation.

In this man it is felt that the lack of post-operative neurological defect due to clipping of both anterior cerebral arteries could be attributed to the fact that he was hypothermic at the time of the ligation and that this state was maintained for a further twenty-two hours after operation.

Case 2

E.P., a female aged 47, was admitted with subarachnoid haemorrhage due to rupture of a large aneurysm on the anterior communicating artery, demonstrated by carotid angiogram. She had a

blood pressure of 130/70 mm. of mercury, normal hepatic function and slightly impaired renal function.

As her condition improved rapidly, surgery was planned for six weeks after the acute episode.

Ten days after the first haemorrhage she developed a second severe haemorrhage and rapidly deteriorated with blood pressure 220/140 mm. of mercury, respirations 30, pulse 80, and temperature 38.6°C.

She was restless and irrational and, at that stage, inoperable.

In view of the raised blood pressure, vegolysen (10 mgms) was given intravenously, sedation and surface cooling were commenced and her rectal temperature lowered to 30°C. Within four hours the picture had changed dramatically — pulse and respiration had slowed and the blood pressure was much lower.

Sedation was periodically lightened and sixteen hours later she was rational and considered fit for surgery. At this stage her temperature was reduced to 27°C (rectal) and 28°C (oesophageal), craniotomy was performed, the aneurysm packed and the left anterior cerebral artery clipped without undue difficulty.

After operation she was maintained below 34°C for forty hours.

Post-operatively she had a hemiparesis which is now recovering rapidly. Her initial mental confusion has also almost disappeared.

There is little doubt that this patient would have died or led a vegetative existence but for the early institution of hypothermia.

Case 3

R.L., a male aged 14, was admitted in a moribund condition with a severe brain stem injury with pulse 160, blood pressure 70/30 mm. of mercury, respirations 40 and temperature 39°C.

As his condition deteriorated rapidly, cooling was commenced and violent shivering occurred which made his condition even worse.

Then sedation with chlorpromazine 50 mgms two hourly plus active cooling was commenced. His temperature was maintained at 34 to 36°C for approximately seven days.

From the commencement of cooling with control of shivering, the whole picture changed — his blood pressure rose, pulse and respiratory rate fell and state of consciousness improved.

Tracheotomy was necessary to maintain an adequate airway. Burr holes were drilled and the brain was seen to be grossly oedematous but a ventriculogram showed no evidence of supratentorial compression.

He took nearly four weeks to recover consciousness but since then his mental state has improved steadily and is now nearly normal.

His stay in hospital was prolonged for several months owing to an associated traumatic spondylolithesis with a cauda equina lesion.

Prior to the induction of cooling this patient was moribund and typically a picture of irreversible cerebral oedema and anoxia.

(b) The heart

As mentioned earlier, the hypothermic heart does not tolerate hypoxia as well as the brain — possibly due to different enzyme systems or to the fact that cardiac activity must continue.

It seems unlikely therefore that anoxic conditions of the heart will benefit from hypothermia.

(c) Pulmonary disease

Swan (1954) has suggested hypothermia in acute insufficiency of respiratory tissue, e.g. pulmonary embolism.

However, the acute case dies before hypothermia can be instituted and the milder case does not require such radical treatment, therefore it may be indicated only in the occasional moderately severe case.

(d) Acute hepatic and renal disease

Hypothermia may be useful in acute insufficiency of these organs. At present it is employed for radical liver surgery but much more knowledge of the physiology of the hypothermic liver and kidney is necessary before we start to employ hypothermia for anuria or acute liver failure.

II. Hyperthermia

Hyperthermia may be:

- (i) Neurogenic in origin — due to disorganisation of heat regulating centre. It is seen in cases of head injury, haemorrhage, post-operative pituitary surgery, thyroid crisis, acute infections.
- (ii) Heat stroke — due to disorder in heat loss.

Hyperthermia results in raised metabolism leading to a disparity between the demand and supply of oxygen to the brain and other organs and hence acute hypoxia. Cardiovascular collapse also occurs.

Cooling in cases of hyperthermia need not be so extreme as in the case of anoxic cerebral disease. Generally it is only necessary to lower the temperature to 34 to 36°C.

In my experience cooling has proved effective in these patients.

III. *Acute infections*

Despite a large range of antibiotics, there are some acute infections — especially pneumococcal and meningococcal, which are not rapidly controlled.

There is some evidence that cooling, while decreasing the metabolism of organisms, does not affect antibody response (Ciocatto and Cattaneo, 1956). Hypothermia may therefore be useful in retarding the activity of the invading organisms so that antibiotics and natural resistance can overcome the attack. In addition, it is useful in preventing the undesirable effects of the associated toxicity and hyperthermia.

TECHNIQUE OF HYPOTHERMIA

As the patient is to be maintained hypothermic for prolonged periods in the ward, procedures must be as uncomplicated as possible.

Surface cooling is employed, by means of application of ice bags or a refrigerating blanket. Ice appears to be preferable because it is more rapid and there is less compression of the body with tendency to produce rise in venous pressure.

Problems of induction of hypothermia are:

(i) *Shivering.* Shivering raises the metabolic rate and prevents cooling. Shivering may be avoided by means of deep anaesthesia, muscle relaxants or heavy sedation. Deep anaesthesia and the use of relaxants involve full-time medical supervision which is undesirable. In addition the control of respiration may be a disadvantage.

(ii) *Sedation.* Heavy barbiturate sedation, as used by Fay, is dangerous in all cerebral cases because of the depressant effect on the respiratory centre. Chlorpromazine has proved most useful in most cases because it not only sedates with minimal respiratory depression but it appears to inhibit muscle spasm and shivering possibly by a peripheral curarizing action, and it also facilitates cooling by means of vasodilation.

Chlorpromazine can be employed safely in unconscious patients who are restless. Sometimes, especially at the time of application

of the ice, patients may tend to become very restless and this can be prevented by combining small doses of pethidine with the chlorpromazine. It is important also that the ice be applied gradually. Chlorpromazine usually has to be given every two to four hours during the cooling stage. Once the patient has reached the desired temperature, smaller maintenance doses will be required.

So far we have had none of the complications which may be attributed to the drug — jaundice or bone-marrow depression.

In some cases, violent shivering will occur and sedation must be pushed to the point of respiratory depression; in these cases the patient should be intubated and curarized until the temperature is at the desired level — at which stage chlorpromazine will probably maintain them. Despite previous assertions, the patient at 28°C and even at 25°C can be quite conscious or only slightly confused although they are readily sedated with minimal doses of drugs.

Maintenance of airway

Many cases will already have a tracheotomy.

In other cases, however, a clear airway is not difficult to maintain provided the patient is nursed on the side.

Hypertension

Hypertension frequently develops during induction of cooling — it is dangerous, particularly in cases of cerebral aneurysm which may "blow" at this stage.

It is due to two factors:

- (a) Shivering.
- (b) Intense vasoconstriction with the application of cold.

This hypertension can appear even when the patient is fully curarized but is readily prevented by a small dose of intravenous vegolysen (10-20 mgms.).

Maintenance of cooling

This is not difficult because the cooled patient shows little tendency to warm up if shivering is avoided.

Occasional sponges, and fans will readily maintain them at the desired temperature.

Posture

Head-up position is preferable unless blood pressure is unrecordable. Bed sores and hypostatic pneumonia do not appear to be a problem.

Maintenance of nutrition

The caloric intake must be lowered in accordance with the decreased metabolism. A low protein diet should be given because of the tendency to rise in non-protein nitrogen.

There is good evidence that intestinal mobility and absorption is not affected by low temperatures (Kuenzel and Todd, 1929), therefore patients can be fed by stomach tube.

As a rule intravenous therapy is unnecessary except in cases of shock or blood loss. However, a needle should be placed in a vein prior to induction because vasoconstriction may make the procedure very difficult at a later stage.

It is claimed by some that glucose should not be employed because it is not utilized and, if given, only causes dilution of plasma electrolytes (Rob, 1956).

On the other hand, experimental workers have reported a marked hypoglycaemia at very low temperatures although this has not been my experience.

Large quantities of citrated blood should be avoided because it is thought that the associated decrease in calcium ions or increase in citrate may be a factor in the production of cardiac arrhythmia (Howland *et alii*, 1956).

Routine observations

Careful attention must be paid to all observations of pulse, blood pressure and respiration.

E.C.G. control is essential during the induction; and a pacemaker is most valuable.

Electrolytes, haematocrit, pH, blood sugar should be observed daily and the renal output must be measured carefully.

There must also be at hand equipment to deal with all complications.

Rewarming

So far, the tendency has been to rewarm as quickly as possible after surgery.

As a result of active rewarming one sees reports of cardiac failure due to sudden vasodilatation with a still reduced circulating blood volume. Ventricular fibrillation may also occur. There is a tendency for an over-swing of temperature and a mild hyperthermia of 37-39°C may develop. In addition severe metabolic acidosis has been reported (Brewin *et alii*, 1956).

I consider active rewarming undesirable unless severe cardiac arrhythmia is present.

In the absence of complications, I now allow hypothermic patients, both for surgical and therapeutic purposes, to rewarm spontaneously over a period of eight to twenty-four hours.

COMPLICATIONS OF HYPOTHERMIA

I. Central nervous system

There appear to be no permanent ill effects on brain cells (Callaghan *et alii*, 1954; Loughheed and Kahn, 1955).

Swan has reported twelve cases of peripheral nerve palsy probably due to placing of E.C.G. leads and not to nerve damage (Swan *et alii*, 1956).

We have had two cases of palsy of recurrent laryngeal nerves — most likely due to dissection and pressure round the common carotid artery.

II. Cardiovascular system

(a) Hypertension during induction has already been mentioned.

(b) Hypotension — a progressive hypotension occurs as the temperature falls — this is usually accompanied by a marked fall in pulse pressure.

However, hypotension does not always occur, particularly in young, fit individuals.

Owing to vasoconstriction, blood pressure may be very difficult to obtain, especially by auscultation. In cases where the blood pressure has been unrecordable arterial cannulization has shown the pressure to be 80/70 mm. of mercury; such means of recording is not practicable in the prolonged case.

The hypotension of hypothermia is accompanied by vasoconstriction and is in marked contrast with that due to ganglionic blockade where vasodilatation is necessary in the brain

to maintain an adequate blood flow. The vasoconstriction and hypotension of hypothermia are safe because they go hand in hand with decreased oxygen requirements.

(c) Bradycardia — this is a physiological phenomenon and is indicative of generally lower metabolism and conduction of heart muscle due to a direct action on the pacemaker.

The heart rate will speed up with both atropine and chlorpromazine but to a much greater extent with ganglion blockers.

If there is any cardiac defect, the pulse rate should not be allowed to drop below 40-45.

(d) Cardiac arrest.

Ventricular standstill is most likely to occur at very low temperatures but can occur rarely at higher temperatures. The heart is readily started by cardiac massage.

Ventricular fibrillation — the hazard appears to be greatest below 30°C and on rewarming. It most commonly occurs in cardiac cases associated with handling the heart or clamping the great vessels.

There have been many theories about the causation of fibrillation — low pH, and hypercarbia (Swan, 1953); high muscle potassium (Montgomery *et alii*, 1954); low ionized calcium (Howland *et alii*, 1956): It is difficult to defibrillate the cold heart and, although various drugs have been suggested, electrical defibrillation and rewarming are the best measures.

Arrhythmia is not a great hazard in therapeutic hypothermia where the cardiovascular system is usually normal. Cooling is not undertaken in patients whose previous E.C.G. shows myocardial ischaemia.

There are no definite E.C.G. changes for any particular temperature level — young, fit patients show little variation and I have had one boy at an oesophageal temperature of 25°C who showed a normal sinus rhythm and a bradycardia.

Any of the following changes may occur but, except for arrhythmia, are not of great significance:

(i) Prolongation of P.R. and Q.R.S. and increase in diastole.

(ii) Diminution in amplitude, absent or inverted P waves.

(iii) Notching of Q.R.S.

(iv) Elevation of S.T. segment.

(v) Peaking of T wave, depression of T waves, inversion of T waves.

(vi) Auricular flutter and fibrillation.

(vii) Nodal rhythm.

(viii) Multiple Extrasystoles.

(ix) Ventricular tachycardia and ventricular fibrillation.

III. Respiratory system

Hypothermia does not produce respiratory depression until the temperature reaches 18-22°C. Respiration will be depressed and may cease at much higher temperatures if barbiturates or other central depressants are employed. This does not occur with inhalation anaesthesia (Fisher *et alii*, 1955).

Respiratory acidosis has been reported by Bigelow and other workers. This in part is due to respiratory depression and may also be due to altered solubility of carbon dioxide in blood at low temperatures. It was originally advocated that hyperventilation was necessary to maintain a normal pH and so avoid ventricular fibrillation. This appears to be unnecessary if there has not been excessive sedation.

IV. The liver and kidney

One of the most controversial reports in hypothermia has been that of Knocker (1955) who demonstrated microscopic changes in the liver, kidney and adrenal of dogs similar to the changes in stress as described by Seyle.

Other workers have not been able to produce her results — possibly because her animals were sacrificed while still cold and may have been hypoxic and acidotic.

It is probable that liver damage occurs only in cases of raised central venous pressure associated with clamping of the great vessels.

We have performed hepatic function tests of six of our patients who had undergone periods of hypothermia varying from eight hours to forty-six hours — these tests included bromsulphthalein excretion and serum electrophoresis — both sensitive tests of impaired

liver function. They were performed two days and seven days after normal temperatures were attained.

In no case was bromsulphthalein excretion impaired. In one case there was a slight increase in the globulin fraction on electrophoresis on the second day which had disappeared by the seventh. This patient had had his thoracic aorta clamped for one hour.

Urinary excretion is said to cease at very low temperatures. All we have observed is an oliguria at the temperatures we employ. We do routine pre- and post-operative renal function tests and there has been no impairment of function following hypothermia, even in the one patient who had impaired function at the beginning.

V. Metabolism

There is a great deal of conflicting information regarding metabolic changes during hypothermia, chiefly due to variable conditions — anaesthetic agents, type of respiration, duration and degree of hypothermia, and the presence of circulatory occlusion.

It is almost certain that a metabolic acidosis does appear with cooling but this is much less severe if there is no circulatory occlusion with the attendant raised central venous pressure (Brewin *et alii*, 1956).

Swan regards acidosis as an important contributing factor to ventricular fibrillation. However, Fisher *et alii* (1955) find that the change to acidosis is gradual and that even at 22°C dogs can modify their ventilation and compensate for changes in pH. There is little evidence indicating the changes in humans during prolonged cooling.

Electrolytes: Again there is much confusion. There appears to be little change in potassium and calcium. Potassium may rise initially but returns to normal levels.

Plasma protein tends to fall at very low temperatures.

VI. Blood picture

There is no doubt there is a haemoconcentration.

There is a prolongation of clotting time and, in dogs, there is absence of clotting at 20°C. Possibly there is sufficient stasis to lead

to intravascular clotting during low temperatures, and this may result in pulmonary emboli. Ellis *et alii* (1957) suggest this intravascular clotting may deplete the blood of clotting factors and lead to haemorrhage during rewarming. This would only apply to rapid rewarming.

SUMMARY

Hypothermia is not a therapeutic measure *per se* — it merely lowers metabolism and permits the vital organs to withstand prolonged hypoxia. Therefore, the prime indication for therapeutic hypothermia must be reversible hypoxia of vital organs.

At present the greatest application is in disorders of the central nervous system. To be effective the temperature must be lowered to a point where metabolism is appreciably diminished. The highest useful temperature for central nervous system disorders is 30°C and probably much lower temperatures are more effective, especially if a major blood supply to a portion of the brain or spinal cord is to be interrupted.

In cases of hyperthermia and in acute infections it is probably not necessary to cool below 32-34°C.

The technique involves surface cooling with sedation to control restlessness and shivering; so far chlorpromazine appears to be the best agent for this purpose. Initial hypertension is controlled by vegolysen.

The procedure does not appear to be particularly hazardous provided detailed precautions are observed. The chief danger is ventricular fibrillation which is not a common complication in this type of patient who usually has a normal cardiovascular and respiratory system.

There is much conflicting experimental evidence on the metabolic effects of prolonged hypothermia.

It is important that we determine in human beings the significance of these alterations in metabolism and particularly whether these changes are normal physiological phenomena for the lower temperatures. It must also be ascertained whether the complex changes associated with hypothermia can be reversed after prolonged periods of low temperatures.

With greater knowledge of the physiology, better sedatives and drugs to control shivering and more careful monitoring of the patient, we should be able to achieve even lower temperatures.

There is every indication that, under these conditions, hypothermia will have a definite place as an adjunct to modern therapy.

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I am indebted to Professor R. Lovell, Mr. R. S. Hooper, Mr. J. B. Curtis and Mr. Grayton Brown for permission to publish case histories of their patients. I also wish to acknowledge the tolerance of my neuro-surgical colleagues in permitting me to undertake such elaborate procedures on their patients.

REFERENCES

- BEEVOR, C. I. (1909), *Philos. Trans. B.*, vol. 200, page 1.
- BIGELOW, W. G., LINDSAY, W. K., HARRISON, R. C., GORDON, R. A., GREENWOOD, W. F. (1950), *Amer. J. Physiol.*, vol. 160, page 125.
- BIGELOW, W. G., LINDSAY, W. K. and GREENWOOD, W. F. (1950), *Ann. Surg.*, vol. 132, page 849.
- BREWIN, E. G., NASHAT, F. S. and NEIL, E. (1956), *Brit. J. Anaesth.*, vol. 28, page 2.
- CALLAGHAN, J. C., McQUEEN, D. A., SCOTT, J. W. and BIGELOW, W. G. (1954), *Arch. Surg. (Chicago)*, vol. 68, page 208.
- CIOCOTTO, E. and CATTANEO, A. D. (1956), *Anaesthesiology*, vol. 17, page 16.
- ELLIS, P. R., KLEINSASSER, L. J. and SPEER, R. J. (1957), *Surgery*, vol. 41, page 198.
- FAY, T. (1940), *N.Y. St. J. Med.*, vol. 40, page 1351.
- (1945), *Res. Publ. Ass. nerv. ment. Dis.*, vol. 24, page 611.
- FISHER, B., HAPPEL, J. RUSS, C. and PRENDERGAST, P. (1955), *Arch. Surg. (Chicago)*, vol. 71, page 431.
- HOWLAND, W. A., BOYEN, C. P. and SCHWILZER, B. (1956), *Amer. J. Surg.*, vol. 92, page 555.
- KNOCKER, P. (1955), *Lancet*, vol. 2, page 837.
- KUENZEL, W. and TODD, T. W. (1929), *J. Lab. clin. Med.*, vol. 15, page 132.
- LOUGHEED, W. M. and KAHN, D. S. (1955), *J. Neurosurg.*, vol. 12, page 226.
- MONTGOMERY, A. V., PREVEDEL, A. E. and SWAN, H. (1954), *Circulation*, vol. 10, page 721.
- PENROD, K. E. and GROSSMAN, M. S. (1949), *Amer. J. Physiol.*, vol. 156, page 177.
- ROB, C. (1956), (Discussion) *Proc. roy. Soc. Med.*, vol. 49, page 353.
- REINKE, J. J. (1875), *Dutch Arch. klin. Med.*, vol. 16, page 12.
- ROSOMOFF, H. L. (1956), *J. Neurosurg.*, vol. 13, page 332.
- and HOLADAY, D. A. (1954), *Amer. J. Physiol.*, vol. 179, page 85.
- and GILBERT, R. (1955), *Amer. J. Physiol.*, vol. 183, page 19.
- SHELLSHEAR, J. L. (1920-21), *J. Anat. (Lond.)*, vol. 55, page 27.
- SMITH, L. W. and FAY, T. (1939), *J. Amer. med. Ass.*, vol. 113, page 653.
- SWAN, H. (1953), *Ann. Surg.*, vol. 138, page 360.
- (1954), *Arch. Surg. (Chicago)*, vol. 69, page 597.
- , VIRTUE, S., BLOUNT, G. and KIRCHER, H. (1956), *Ann. Surg.*, vol. 142, page 3.
- TALBOT, J. H. (1941), *New Engl. J. Med.*, vol. 224, page 281.
- VAN DER EECKEN, H. M. and ADAMS, R. P. (1953), *J. Neuropath.*, vol. 12, page 132.

Books Reviewed

THE ANATOMY OF CONGENITAL PULMONARY STENOSIS.

By Sir RUSSELL BROCK, M.S., F.R.C.S., F.A.C.S. (Hon.). London: Cassell & Co. Ltd., 1957. 6½" x 9½", x plus 114 pp, 76 illustrations. Price: 30s. net.

This is an excellent little book which describes the outflow tract of the right ventricle and its abnormalities, in a way that has not before been attempted. Sir Russell Brock pioneered the surgery of pulmonary stenosis by the trans-ventricular route, and in doing this made a very complete study of the structure and function of the right ventricle, which is now published as a monograph. He pays tribute to the accurate work of Sir Arthur Keith at the beginning of the century and discusses the embryology and comparative anatomy of the region, and describes the different types of pulmonary stenosis on the basis of his extensive practical experience in the operating theatre.

Brock has checked and counter-checked his findings again and again, and although most of the book was written five years ago, publication was deliberately delayed until greater experience had confirmed the truth of his observations.

Sir Russell has added another best-seller to his earlier publications, and this book is an important addition to the library of any physician or surgeon interested in heart diseases. It is profusely illustrated and written with a simplicity that makes it easy to understand a very complex piece of developmental anatomy.

SURGERY OF THE ANUS, ANAL CANAL AND RECTUM.

By E. S. R. HUGHES, M.D., M.S.(Melb.), F.R.C.S. (Eng.), F.R.A.C.S., Edinburgh: E. & S. Livingstone Ltd., 1957. 6½" x 9½", xi plus 303 pages, 276 figures. Price: £2 10s. stg.

A useful contribution to surgical literature is the appearance of the latest book by E. S. R. Hughes, "Surgery of the Anus, Anal Canal and Rectum." The book is very well designed with many illustrations, both photographs and line drawings. The author's own black and white sketches, which are by now well known in surgical literature, are useful aids. In describing the nerve supply of the rectum it is stated that the para-sympathetic supply comes from the 2nd, 3rd and 4th segments of the cord. I presume the author means the sacral segments.

The section dealing with anal fistulae is well done and the author's predilection for skin grafting the large raw area is given free play. It would appear that in the author's hands this method is successful in bringing about more rapid healing and a shorter hospital stay. Time will show whether it is suitable for general application by the average surgeon. However, the author is to be congratulated on the excellent results he has obtained in the treatment of some of the more difficult ano-rectal fistulae.

The section dealing with haemorrhoids is standard and requires no comment; it reflects the teachings of St. Marks Hospital. Not all surgeons would agree that simple ligation is free from danger.

In large and extensive pilonidal sinuses, it is to be noted that the author does not favour excision and primary suture but he favours the use of primary suture in what he calls a small sinus and it would appear that his skin grafting operation is preferable to primary suture. Primary skin grafting is also advocated after the excision of anal fissure.

A useful chapter is devoted to prolapse of the rectum. The synchronous combined operation is favoured by the author. A valuable survey of the literature on this difficult subject is given and once again illustrations are profuse.

Pruritis ani, when extensive, is treated by the author by excision and primary skin grafting. The section on carcinoma of the rectum reflects the author's current views, emphasis being placed on the anterior resection of the rectum for growths 10 cms. from the anus. The author claims that anterior resection and end-to-end anastomosis is best done without preliminary colostomy as complications are almost negligible "provided there is no tension on the anastomosis and the blood supply to both ends is liberal and the technique has been meticulous." This is not the experience of all general surgeons. The standard operation of combined abdomino-perineal excision of the rectum is advocated with growths below 10 cms. of the anus and subcutaneous colostomy is favoured, the opening being just below the umbilicus. A useful section on the management of colostomy is provided.

The historical appendix, together with several copies of ancient prints throughout the book, indicate that the author has made some study of the history of surgery.

The book is an excellent production and can be recommended as a handy reference on current proctological practice.

TROPHOBLASTIC GROWTHS, HYDATIDIFORM MOLE AND CHORIONEPITHELIOMA.

By J. SMALBRAAK, M.D. Introduction by late EMIL NOVAK, M.D., D.Sc. London: Cleaver-Hume Press Ltd., 1957. 6" x 9", xii plus 342 pp., 66 figures. Price: 72s.

This book, well produced and with excellent illustrations, is a most able and comprehensive survey of a difficult and fascinating subject.

The follow-up of the patients whose case histories is presented is most detailed and complete, and this obviously is responsible for the restrained and objective approach that the author has to the pitfalls and uncertainties that surround hydatidiform mole and chorionepithelioma. Equally it seems responsible for the conservative attitude he has towards the treatment in these patients. The case histories illustrate how rewarding a conservative attitude can be.

Practitioners whose work is likely to bring them into contact with these conditions will find time spent with this book well rewarded.

PRE- AND POST-OPERATIVE CARE IN THE PEDIATRIC SURGICAL PATIENT.

Edited by WILLIAM B. KIESWETTER, M.D. Chicago:
The Year Book Publishers, 1956. 5" x 8", 347 pp.,
47 figures.

This book is a pocket-sized manual of 347 pages. A wide range of surgical conditions of children is covered dealing with abdominal, pelvic, thoracic and neurological diseases and their management.

The early chapters in this book describe in a broad way fluid and electrolyte balance, anaesthesia, and post-operative management of infants and children. They include many useful tables and dosage schemes which would be helpful to surgeons, practitioners and hospital medical officers.

The later chapters are devoted to brief enumerations of symptoms and signs of clinical conditions and their surgical management. The cardinal features, the investigations, differential diagnosis, and pre-operative and post-operative orders are tabulated. This itemizing of medical data without qualification or explanation serves a limited purpose in the general management of patients and the investigations advised appear, in many instances, to be more liberal than required for routine use.

The information supplied in the first part of this book is useful to doctors who have the general management of pediatric patients. The second half is too abbreviated to be of much value to the pediatric surgeon but it would provide a handy pocket-sized reference volume for house surgeons who have responsibilities in the care of surgical conditions in children.

This small book is unique in its wide coverage of pediatric surgical conditions. For this reason it is of value to doctors who meet the surgical problems of infant and children only occasionally, and to country surgeons who have the sole responsibility in the management of the diverse problems.

MEDICINE AND THE NAVY, 1200-1900.

Volume 1. 1200-1649.

By J. J. KEEVIL, D.S.O., M.D. Edinburgh: E. & S. Livingston Ltd., 1957. 9" x 6½", xii plus 255 pp., frontispiece and 14 plates. Price: 40s. stg.

This is the first part of a comprehensive and authoritative work which the author has been working on for a number of years and which will be completed in four volumes. It is strange that the history of naval medicine has not received adequate attention long before now but this work most admirably makes up for the long silence.

The early part of the book deals with a period notoriously lacking in documentation particularly in the medical field and Surgeon Commander Keevil has wisely related medicine to general historical facts and contemporary happenings. The paucity of precise information has involved some speculation as to detail but the story is most expertly written.

The medieval ships of war were the personal property of the King, were only equipped and victualled for short voyages and most of them carried no medical officers. In times of emergency surgeons or apothecaries could be pressed into service to care for the wounded. Seamen disabled by illness or wounds received scant attention from the State, the fortunate ones were cared for in Houses of Pity, the rest looked after themselves. Even in the seventeenth century there were no naval hospitals,

the sick and wounded being admitted to the civil hospitals in the large cities. Until 1590 there was no administrative machinery for payment of pensions to the disabled but in that year the Chatham Chest was founded into which each seaman contributed sixpence per month and from which some compensation was allowed. Subsequently the medical care of the Navy developed and expanded and the author gives an excellent account of its growth. Outbreaks of typhus and scurvy were common especially on the long voyages of the Tudor period and the medical attempts to combat these scourges naturally occupies much space in this book. The wastage of seamen due to disease on all voyages was an enormous problem.

The Navy made great use of the Company of Barber-Surgeons of London both for provision of medical and surgical equipment and medical officers, and this relationship is well described.

The author gives a most stirring account of the many voyages of exploration and of naval engagements, many under conditions of the greatest hardships. His story is most meticulously documented with lists of his sources at the end of each chapter; the number of these giving some idea of the enormous amount of research that has gone into the production of this volume.

Surgeon Commander Keevil is to be congratulated on giving us, at long last, a definitive history of naval medicine and we look forward with keen anticipation to the succeeding volumes. His work is a most notable addition to the long series of books which have been published with the financial support of the Wellcome Trust.

The publishers are to be commended for the design and printing of this excellent work.

TEXTBOOK OF BRITISH SURGERY. (Volume 2.)

Edited by Sir HENRY SOUTTAR, C.B.E., D.M.(Oxon.), F.R.C.S. London: William Heinemann Medical Books Ltd., 1957. 9½" x 7", viii plus 694 pp., 349 illustrations. Price: £5 5s. stg.

This volume covers the central nervous system, the eye, ear, nose and throat, mouth, salivary glands and jaws, neck, breast, oesophagus and the heart and lungs. The various chapters are written by acknowledged leaders in each field in Great Britain although one author now claims a Commonwealth home. As is proper in the teaching of surgery each subject is introduced by a short discussion on the appropriate anatomy, pathology and physiology. Each subject is dealt with adequately although all will not agree with many statements made such as, in the treatment of hiatus hernia, "The incision in the diaphragm is closed and no attempt is made to narrow the hiatus which will rapidly adapt itself to the size of the oesophagus."

The text is dogmatic as is right in a work designed for the senior registrar, postgraduate student of surgery and for the general surgeon. A practical outlook is adopted by all authors and the work is profusely and beautifully illustrated. The text is well set out, easy to read and, for the student, it should be easy to learn.

This volume should stand beside Volume I in the library of all surgeons and it is yet another work that indicates the high standard of British surgery today.

THE STUDENT LIFE.**THE PHILOSOPHY OF SIR WILLIAM OSLER.**

Edited by RICHARD E. VERNEY, M.B., F.R.C.P.E., D.R. Edinburgh and London: E. & S. Livingstone Ltd., 1957. 7½" x 5", xiii plus 214 pp., frontispiece. Price: 15s. stg.

This is a collection of quotations from the writings of Sir William Osler designed principally for medical students to give them an insight into Osler's philosophy. They are full of sound common sense and wisdom and are as useful today as when they were written. The editor has modernized the original to some degree and added helpful footnotes. While some of the quotations are mere paragraphs, a few of Osler's talks have been reprinted in full. There is no doubt that they would assist the thoughtful student to an understanding of the art of medicine.

While these extracts will probably fulfil the purpose for which they were designed it is felt that the only way to appreciate Osler's philosophy and his approach to medicine is to read his original texts in full.

FUNDAMENTALS OF GENERAL SURGERY.

By JOHN ARMES GIUS, M.D., D.Sc.(Med.), F.A.C.S. Chicago: Year Book Publishers, 1957. 6" x 9", 720 pp., 151 figures. Price: \$12.50.

This really excellent book should be brought to the notice of all undergraduate and postgraduate students and those associated with the teaching of students in surgery. It fills a very valuable place. In one volume of nearly 700 pages the physiology, biochemistry and pathology so germane to an appreciation of the basis of surgery is presented in addition to a good clinical appreciation of each subject. Hitherto it has been difficult to find such an adequate cover within the confines of one book and now this is available and with 1957 standards. All teachers would be more than happy if their students had the type of approach so well set out. A great service has been rendered, too, to practising surgeons with their interest in the mechanisms underlying disease.

A SYNOPSIS OF SURGICAL ANATOMY.

By A. LEE MCGREGOR, M.Ch., F.R.C.S. Eighth Edition. Bristol: John Wright & Sons Limited, 1957. 7½" x 4½", viii plus 808 pp., 766 illustrations. Price: 32s. 6d. stg.

It is no exaggeration to state that most Commonwealth surgeons at some stage in their career have read this book from cover to cover and for many it has represented their basic training in the anatomy of surgery. When this work first appeared in November, 1932, it was hailed by all, from student to consultant surgeon, as a best seller, and so it has proved to be, now reaching its eighth edition, as well as having been reprinted on nine occasions. Many academic anatomists point out that there are errors in the text and, to a minor degree, there may well be although this may be said of almost all textbooks of surgical anatomy. To convey to students and surgeons the essentials of anatomy that are required in the diagnosis and treatment of patients requires great correlation and integration of facts and the demand for this book indicates how successful are the author's methods.

The vast majority of the text is very familiar but there have been some additions such as the sections on diaphragmatic hernia, adrenalectomy, paragangliomas and lymphatics. One can have nothing but praise for this book which every student purchases and every surgeon values. It still remains the standard work on surgical anatomy in the English language.

LEHRBUCH DER SPEZIELLEN CHIRURGIE. (Volumes 1 and 2.)

By RICHARD GOLDHAHN and GERHART JORNS. Leipzig: Georg Thieme, 1955-1956. 9" x 7". Volume 1, xvi plus 507 pp., 235 illustrations; Volume 2, xv plus 608 pp., 342 illustrations. Price: Volume 1, DM 50; Volume 2, DM 66.

This book was two-thirds written by Dr. Goldhahn, and after his death in 1945 it was finished by Dr. Jorns. It is in two volumes, the first published in 1955, the second in 1956. It is what its title suggests, a textbook: designed as its author says in his foreword "to present the basis of special surgery for the information of students and young doctors." Its claim to deal with "Special surgery" rests apparently on the fact that it deals with surgical problems on a regional or systemic basis. The first volume covers from the scalp to the diaphragm; the second the rest of the trunk and the limbs and joints. But its scope, within this framework, is so comprehensive that, with the exception of a section on gynaecology, there seems little that need be added to make it a textbook of general surgery.

Its declared object, directed as a textbook to students and general practitioners, is borne out by its contents, and as such a textbook it is undoubtedly a very good one. Major emphasis is placed, after notes on the relevant anatomy and pathology, on the clinical appearances. And the treatment, wherever it is outside the scope of the general practitioner, is indicated rather than described. For instance, the immediate treatment of an oesophagus damaged by caustic fluids is described in some detail, but the operative treatment of such a condition as carcinoma of the larynx is given nine lines only.

The whole tone of the work is excellent. Statements of treatment are modern yet reasonably conservative. There is nothing that would strike an Australian graduate as strikingly novel, but it is all well set out, and is very well illustrated by diagrams prepared by the son of the original author, Dr. Goldhahn. For German-speaking students and doctors I can well imagine this book becoming a standard textbook. It would not, I should think, offer to an English-speaking clientele more than they could get from English works of similar type.

SIR GEORGE BUCKSTON BROWNE.

By JESSIE DOBSON, B.A., M.Sc., and Sir CECIL WAKELEY, Bt., K.B.E., C.B., LL.D., D.Sc., F.R.C.S., F.R.A.C.S., F.A.C.S. Edinburgh and London: E. & S. Livingstone Ltd., 1957. 9" x 6½", viii plus 143 pp., frontispiece and 28 illustrations. Price: 25s. stg.

George Buckston Browne (1850-1945) will always be remembered as one of the notable benefactors of the Royal College of Surgeons of England where his name is perpetuated by the Research Farm at Downe, Kent, and a biennial dinner. He had, of course, many other interests and gave generously to a number of organizations but he is best known by

his generosity to the College. Up until now he has lacked an adequate biography, but this has been written by the Curator of the Hunterian Museum and by a Past President of the College.

When he was over ninety Browne wrote notes on his life and training as a genito-urinary surgeon and these notes, in his own words, form the basis for much of this biography. Trained by the great Sir Henry Thompson, Buckston Browne developed a very large practice in his chosen speciality and this in spite of the fact that he held no hospital appointment. His story makes most interesting reading, particularly his skill with a catheter and his practice in the days before prostatectomy was a routine operation. One reads with interest, and some amazement, of patients who "lived the catheter life for twenty-four years." He trained his patients in the minutiae of sterilization of catheters and would not let them leave hospital until they could look after themselves to his satisfaction.

Miss Dobson and Sir Cecil Wakeley have added accounts of Buckston Browne's forbears, his many benefactions and his life in retirement. Their story gives us an excellent picture of a remarkable man.

THE CLOSED TREATMENT OF COMMON FRACTURES.

By JOHN CHARNLEY, B.Sc., M.B., F.R.C.S. Second Edition. Edinburgh: E. & S. Livingstone, 1957. 10" x 7", xii plus 259 pp., 199 illustrations. Price: 50s. stg.

This edition has 70 pages of new matter contained largely in over 30 additional pages to the section of fractures of the tibia and fibula and a new long introductory chapter. And the reader will have to concentrate if he wishes to follow the various arguments and the range of subjects upon which the author dilates under the heading of this chapter—"Conservative versus operative treatment." Thereafter it is more plain sailing. The author writes with vigour and clarity; and also without any doubt in his mind about the subjects upon which he ex-

pounds. This is forceful writing and meant to convince. Through the text there is not only a description of the techniques of closed reduction, but he provides what perhaps is more important, numerous observations and advice on different problems inherent in conservative treatment. For example, "controlled collapse" is a further stage of conservatism in the closed treatment. It means that a deformity arising out of the collapse of cancellous bone in a fracture is accepted, especially in the elderly providing that there is no great clinical deformity. This principle is applicable to fractures of the femoral or tibial condyles, intertrochanter fractures of the femoral neck when impacted, impacted Colles's fractures, fractures of the os calcis and so on. Manipulation, reduction or traction to correct a deformity in these fractures leaves a cavity, delayed union and later second recurrence of the deformity may take place.

In the enlarged chapter on the tibia and fibula shaft fractures there are useful pieces of advice on technique, but what is more important didactic indication for operation are expressed in a series of drawings. He recommends less operating on fractures of the tibia than has been performed in the last decade, and it is to be hoped that others will heed this advice.

Skeletal traction is condemned although many surgeons in the past and Böhler at the present day find the method useful if used without excessive weights and only for a short time for comminuted, unstable and compound fractures of the tibia and fibula. Why this gratifying method which only has two hazards that are largely avoidable—separation of the fragments and infection of the bone—has not continued in popularity is hard to explain. It seems rather contradictory that the Stader splint or some modification incorporating the principal of this apparatus appears to be favoured by the author for compound fractures of the tibia in certain instances.

This book is recommended to all surgeons treating fractures.

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